# Teachers and Decisions made in the Process of Developing a Formal Curriculum:

## Case-studies on the Development of a School Programme for Science Excellence in a School-University Network

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# Teachers and Decisions made in the Process of Developing a Formal Curriculum: Case-studies on the Development of a School Programme for Science Excellence in a School-University Network

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In this study, the primary objective was to gain insight into the curriculum decisions made in the process of developing a formal curriculum for science and mathematics excellence. Therefore, three case-studies were conducted in schools who take part in a regional initiative for a school-university programme for talented students in science and mathematics. At the time, participating schools had started developing the school programme. The workshops provided by the university to the teachers developing the programme and a subsequent meeting of the teacher team were observed. Together with follow-up interviews with a teacher from each school, these provided information on the decisions being made and the motivations for these decisions. Most decisions were made about organization of the school projects (i.e. time, place, and grouping on the school-level): local context formed the basis of many of those decisions. It was found that teachers needed clarity on organizational conditions before becoming concerned with the content of the programme. This was especially the case when the programme development coincided with the design of another school-wide programme. In general a lot of construction activities (i.e. on selecting and adapting learning materials) needed to be done at the end of the school year. It can be concluded that attention paid to distinct aspects of the curriculum depends on the larger framework into which this programme is to be fitted, and that therein decisions on time and place or often directive for decisions on didactics of the school projects.

Key words: *curriculum development; formal curriculum; quality considerations; school-based curriculum development; school-university partnerships; science excellence*

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# 1. Introduction

Current education policy in the Netherlands provides schools with opportunities to give shape to education (i.e. the 'how' of education), whereas the initiators of curriculum development (e.g. the government) increasingly provide schools with frameworks for curriculum development (i.e. the 'what' of education) (Ministerie van Onderwijs, Cultuur, en Wetenschap [*Ministry of Education*], 2011b; Thijs & Van den Akker, 2009). This means that schools get more control over what pedagogical-didactical approaches to use and how to create coherence between curricula of the subjects taught in the school (cf. Onderwijsraad [*Education Council*], 2011). This way, the educational concept of the school and the context in which the curriculum is to be implemented, can be taken into account when developing a curriculum (Tobin & Dawson, 1992).

This also allows teachers to get a more active role in the development of the curriculum, starting with its underlying *rationale* (including views and beliefs on *to which end* education serves). Many scholars advocate that acceptance and support among teachers for innovations in education be realized by giving teachers a more active role in curriculum development (e.g. Kuiper, 2010; Pilot & Van Driel, 2001). Thereby, developing a curriculum can be considered as part of teachers' professional development (e.g. Ball & Cohen, 1996; Coenders, 2010) in which curriculum development by teachers is an activity noticed to help them better understand the rationale underlying the curriculum innovation (Coenders, 2010).

With the active involvement of teachers in the process of developing a new curriculum, a challenge presents itself to the curriculum development in the form of teachers' *practical knowledge* and *beliefs*. Building on Van Driel and Verloop (1998) and Verloop, Van Driel, and Meijer (2001), De Kock, Sleegers, and Voeten (2005) defined *practical knowledge* as 'the integrated whole of knowledge, beliefs and values with regard to teaching, that a teacher has accumulated on the basis of his or her personal and professional experiences' (De Kock et al., 2005, p.801). This practical knowledge gives direction to how teachers make plans for their classroom practice (e.g. De Kock, Sleegers, and Voeten, 2005; Van Driel, Beijaard, & Verloop, 2001; Verloop, 1992).

Indeed, in reform efforts, teachers tend to make decisions for future classroom practice that are still very much related to traditional learning environments (De Kock et al., 2005). Furthermore, teachers often focus on the organizational aspects of the curriculum (De Kock et al., 2005; Handelzalts, 2009; dissertation), and thereby most often take into consideration the practicality of curricular aspects (Handelzalts, 2009). In contrast to that, teacher design teams were found to spend less time on more substantive principles of the curriculum, i.e. rationale and goals (Handelzalts, 2009). This illustrates the difficulty of translating the rationale behind curriculum reform into plans

for future practice. It thus comes as no surprise that teachers' practical knowledge is often argued to be the reason why changes in curricula have not been implemented as intended by curriculum developers in the past (e.g. Kuiper, Boersma, & Van den Akker, 2005).

Besides the teachers' involvement, other conditions may to a large extend influence how a school curriculum is being developed and what it results in. Possibilities for a new curriculum may be limited by school characteristics, as well as on organizational conditions provided to the teachers being tasked with designing a curriculum. Handelzalts (2009) concluded in his dissertation that, when teacher design teams are provided with clear organizational conditions, it helps them develop clear reform ambitions, which in turn stimulates the design process. Such organizational conditions may also include clarity on the relationship between the curriculum-development task of the teachers and the other developments on the school level (Handelzalts, 2009).

Also, professional support (Johnson, 1993) and collaborative interactions between teachers (e.g. Erickson, Brandes, Mitchell, & Mitchell, 2005) could help teachers in changing teaching practices. One way to realize change in practices is by means of a university-school partnership, as this could stimulate the development of a theoretically sound curriculum (Johnson, 1993). An external facilitator therein can stimulate discourse on an abstract level (i.e. the rationale behind the curriculum), thereby clarifying the rationale and goals underlying a curricular innovation to teachers, for example. This in turn could help to prevent the occurrence of discrepancy between the intended curriculum and the actual practices.

Although many studies on teachers' roles in curriculum development have focused on the effects on students, little is known on how substantive decisions for a curriculum for science excellence are motivated by teachers *before* implementation of a new curriculum (cf. Nieveen, Handelzalts, & Van Eekelen, 2011). The purpose of this article is to contribute to knowledge on teachers' decision-making in curriculum development *before* implementation of a new curriculum, and to see how such choices are motivated. Therefore, case-studies were conducted in three schools that were in the process of designing a school programme for science and mathematics excellence in grade 11 and -12 of pre-university education.

More specifically, the following study is not about curriculum renewal, but about a specific group of talented/gifted students for which a school programme for science and mathematics excellence had to be developed (individually) by several schools collaborating in a regional university-school network.

## Introducing the case study

PISA (Programme for International Student Assessment) results showed that Dutch students overall score above average, but the number of students on the highest level are low compared to other countries (OECD, 2009). The Dutch Education Council thereafter suggested that gifted and talent students should be offered more challenging education (Onderwijsraad, 2011). Therefore, one of the objectives of the new policy issued by the Dutch Ministry of Education is to increase the learning results for the best-performing 20% of pre-university (Ministerie van Onderwijs, Cultuur, en Wetenschap [*OCW*], 2011a; 2011b).

The Dutch Educational Inspectorate advocates that teachers should be offered more opportunities to differentiate their teaching according to students' differences in cognitive abilities (Inspectie van het Onderwijs, 2011). In accordance with that, the Dutch Ministry of Education wants to maintain professional autonomy of both schools and teachers in fulfilling the aforementioned aims (Ministerie van OCW, 2011b). This leaves schools with the task to offer challenging education according to their own needs, which could vary from extra learning activities within school subjects, to a fully integrated, comprehensive, school-wide programme for talented students.

One of the possibilities mentioned for fulfilling such ambitions is to offer students the possibility to engage in university activities through school-university partnerships (Onderwijsraad [*Education Council*], 2011). In this study, such a school-university partnership has resulted in an initiative for a campus- and school programme for science and mathematics excellence, called 'U-Talent Academy'[2] (hereafter to be abbreviated to 'U-TA'). The university thereby provides the rationale and required elements for a school programme for science and mathematics excellence, which schools get to individually design and implement. Thus, different school programmes will come into existence during the time of the study; those should however be coherent with the campus programme.

## Research question

Although there will be similarities between schools in what is going to constitute the school programme at first sight, they may differ substantially in the assumptions underlying the choices for individual components of the curriculum. As mentioned above, there are many different factors influencing the curriculum development process in schools. Getting to know more about how teachers reason about substantive decisions at such an early stage of curriculum development, may prove helpful in understanding and explaining differences in the practicability and effectiveness of the programme later on.

[2] U-Talent stands for 'Utrecht-Talentontwikkeling, Leven, Natuur en Technologie' (Utrecht- Stimulating Excellence in Science, Technology and Society)

Thus, it will be interesting to see how decisions about the curriculum are motivated by teachers, and what kinds of considerations are used in doing so.

The research question to be answered in this article therefore is: 'What decisions about individual curriculum components are made in the process of designing a curriculum and how are these motivated?'

Because the research covers only a part of the development process, it is necessary to make a distinction between curricular representations. In the next paragraph, the concept of 'curriculum' will be discussed in relation to its distinct forms to be recognized in the curriculum development process, together with the kind of quality considerations that need to be dealt with in order to design a theoretically sound curriculum.

## 2. Theoretical framework

There are countless definitions of the term 'curriculum'. In its most general meaning it is 'a plan for learning' (Taba, 1962). More precisely, a curriculum could be seen as "…the device through which the vast range of knowledge, values, skills and roles which the school offers to its pupils, is organized, taught and eventually evaluated" (Eggleston, 1980, p.1). As reflected in this phrase by Eggleston, distinct curricular representations can be recognized that build on one another. Van den Akker (2003) distinguishes six different curricular representations (Table 1), which are deemed useful in the analysis of the process of curriculum development and its outcomes (Thijs & Van den Akker, 2009).

Table 1 *Forms of Curricula* (based on Goodlad, Klein, & Tye, 1979 and Van den Akker, 2003).

| **Threefold distinction** | **Six-fold distinction** |
|---|---|
| Intended | Ideal (or: 'ideological') |
| | Formal (or: written) |
| Implemented | Perceived |
| | Operational |
| Attained | Experiential |
| | Learned |

At the beginning of this study, schools were presented with the ideal curriculum for a programme of science- and mathematics excellence. The 'ideal curriculum' consists of the intentions, beliefs, views, values, and the like that should be transferred to students (Goodlad, Klein, & Tye, 1979; Van den Akker, 2003). However, in this study the

ideal curriculum provided by the university, also includes four aspects[3] which participating schools are required to incorporate in their school programme. Therefore, the 'formal curriculum' (otherwise called 'written curriculum') is a plan for future implementation of the school programme in which the ideal curriculum is to be included. This formal curriculum can consist, for example, of instructional materials or syllabi. Together with the ideal curriculum, the formal curriculum forms the intended curriculum and this distinguishes it from the implementation phase of curriculum development (Goodlad et al., 1979; Van den Akker, 2003).

When developing a formal curriculum, matters of goals and aims, content, didactics, assessment, and organization have to be decided on. Van den Akker (2003) developed a tool called the 'curricular spider web' (figure 1), which can be used by curriculum developers to address specific elements of the learning process as being planned. It is presumed that changing any one of these components must necessarily lead to changing the components as well (Thijs & Van den Akker, 2009; Van den Akker, 2003). This way, a coherent curriculum can be developed in different stages of curriculum development, starting with the ideal curriculum.

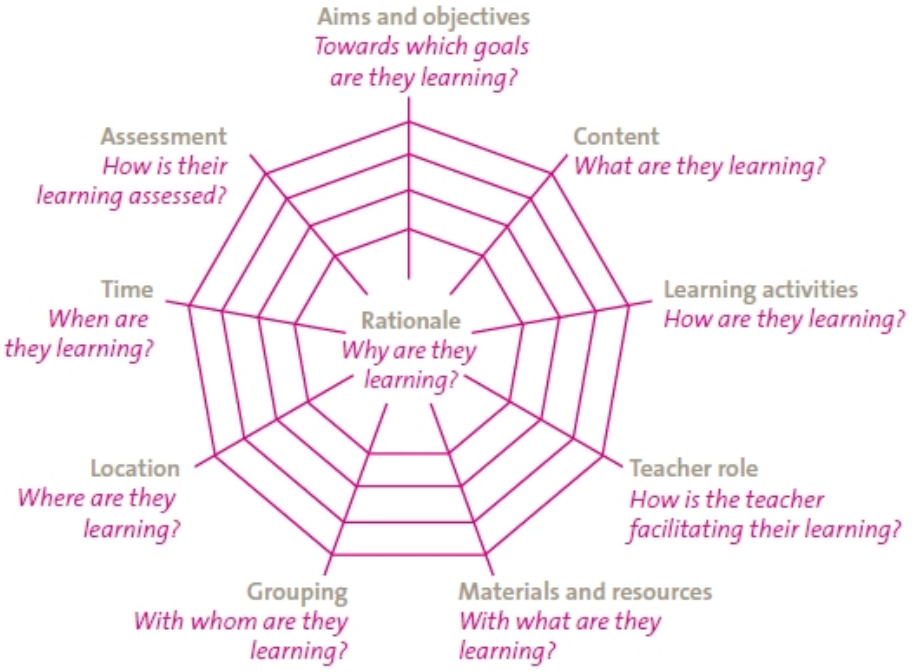


Figure 1 *Curricular Spider Web* (Van den Akker, 2003; Thijs & Van den Akker, 2009).


At the heart of the curriculum the rationale can be found (Van den Akker, 2003, elaborating on Eash, 1991; Klein, 1991). The rationale can be seen as central to the

[3] School projects, forming a learning community, differentiation between students, and embedding learning activities for the campus programme.

other nine components of a curriculum. To exemplify the rationale, one needs to answer the question: 'To which end do students learn?' In other words, the rationale contains the basic philosophy for education, i.e. the ideal curriculum.

In this study, the focus will thus be on the curricular decisions made in the process of forming a formal curriculum. When decisions are made by individual schools on any of the curriculum components, these should be coherent with the rationale, which is (via the ideal curriculum) provided by the university. However, not necessarily all decisions about curriculum components may be anchored into rationale of the curriculum. There are other quality considerations to be taken into account, as will be explained below:

In a theoretically sound curriculum, curricular decisions are based on state-of-the-art knowledge, otherwise called relevance. Nieveen (1999), elaborating on Nieveen (1997), defined 'relevance' as one of four quality markers useful for evaluation of curriculum products. Ideally, relevance should be evaluated together with 'consistency' when developing a formal curriculum. Consistency refers to curriculum components being consistently linked to one another.

The other two quality criteria are 'practicality' and 'effectiveness'. In the context of school-based curriculum development, meeting up to the quality criteria of practicality means that the needs, wishes and contextual constraints of the students and/or teachers are taken into account. But practicality also means that (part of) the curriculum is expected to be useable in a way that is compatible with the developers' intentions. On the other hand, effectiveness means that the programme (or a part of it) is appreciated by the students and/or that desired learning takes place.

Although 'practicality' and 'effectiveness' can be evaluated in resp. the implemented-, and the achieved curriculum-forms, Nieveen (2009) suggests that these quality markers could be addressed in earlier stages of curriculum development. Based on the expectations on the implementation phase- and the outcome of the curriculum, practicality and effectiveness of (part of) the curriculum may be addressed by teachers when in the process of decision-making. It is thus expected that whenever teachers refer to 'expected practicality' in justifying decisions on individual curriculum components, they will base themselves on their practical knowledge and on the context in which the curriculum is to be designed. The same holds for the quality marker 'effectiveness'; there is it expected that teachers will often refer to the positive outcomes of similar programmes as they have experienced it.

# 3. Case-studies: design and methods

The research was conducted in three schools, in the setting of schools participating in regional school-university collaboration to promote science and mathematics excellence in pre-university education (called 'VWO' in the Netherlands). At the time, these schools were all in the process of developing their own school programme for science and mathematics excellence.

In this university-school partnership, a university-programme for science- and mathematics excellence in its original format was called 'Junior College Utrecht' (JCU). This format has existed from 2004 up until 2013. In that programme, talented 11th-grade and 12th-grade students from pre-university level education (VWO) were offered the chance to participate in a university-programme for science- and mathematics excellence. Other goals have been to develop and experiment with new instruction materials as part of professionalization activities and to promote schools' development.

As of September 2013, JCU will offer a less extensive campus programme in a new initiative for a school-campus programme for science- and mathematics excellence, called 'U-Talent Academy'. U-Talent stands for 'Utrecht- Stimulating Excellence in Science, Technology and Society' (Utrecht-Talentontwikkeling, Leven, Natuur en Technologie). Hereafter the term U-Talent Academy will be abbreviated to 'U-TA'. In this programme, students will be stimulated to 'dig deeper' into- and broaden their knowledge of science subjects and science research. Because these students will spend less time at the university, their own schools will develop a programme for science- and mathematics excellence as well, as part of the regional initiative. The idea is to have more students to become involved in this programme, eventually.

In the months before the programme is to be implemented, teachers and school leaders from the 23 schools involved in developing this school programme will be introduced with the ideal curriculum for U-TA. This means that external facilitators from the university have previously decided on specific elements to be incorporated the school programme (explained below). Teachers and school leaders were responsible to make decisions on how to incorporate those elements into a curriculum for science and mathematics excellence.

The goal of U-TA is to stimulate educational development and to provide an uninterrupted learning pathway for motivated students throughout secondary science education, with a better connection to bachelor science programs. These goals are in line with national policy concerning the promotion of excellence in secondary education (Ministerie van OCW, 2011). JCU furthermore requires the participating schools to incorporate the following elements in the U-Talent school programme:

1. Differentiation in the main science subjects:
   Because of participation in U-TA, participating students will have less time to spend on the regular curriculum. The programme therefore also aims at facilitating students in order to work through the regular curriculum at a higher pace.
   Another option is to allow students to learn according to their own learning preferences. This means creating possibilities for students to put their academic skills and –attitude to use by having them work independent from the teacher, have more open-ended assignments in contrast to predetermined assignments, and possibly also have them learning on a more advanced level.
2. Preparation activities for on-campus activities, as well as subsequent concluding activities:
   In order to create coherence between the campus- and school-programme, students participating in the campus programme have to do some preparatory- and concluding activities of this programme at their own school. This is needed to prevent that the activities on campus become isolated happenings. There should be a continuous demand for the use of academic skills and –attitude, and the opportunities for advanced learning activities ("verdiepingsmogelijkheden") at school.
3. Science projects for each of the basic science disciplines with a study load of 15 hours per discipline per year:
   A study load of 120 hours in total should be spend on science projects in 11th- and 12th grade together. The common goals of these projects are to have students experience freedom within the school environment to immerse themselves in a subject; to have them develop academic skills and –attitude, and to have students experience the passion that teachers have for their subjects.
4. Facilitate both teachers and students to form a 'learning community', in which they will continue to motivate and challenge each other for science excellence:
   The group of students participating in a school programme of science excellence should develop into a community within their school. This community should contribute to the school community by means of their special interest in science, their growing academic attitude and their motivation to achieve more, to work together and to orient themselves on future possibilities.

## 3.1 Approach and case selection

In this research, three schools served as separate cases, each of which has gathered a team of school leader and teachers representing different school subjects, which will be concerned with developing the school programme for U-Talent Academy. Hereafter, this team will be referred to as the 'U-TA team'. Just the same, when

mentioning 'the school leader', it refers to the school leader part of the U-TA team and/or the one who has ultimate responsibility over the programme. In each case, one teacher is appointed as the 'coordinator' of the school programme; this is also the teacher to be interviewed in this study.

The approach used in this research is that of a *multiple embedded case study*, as the focus will be on multiple aspects of the cases under scrutiny (Yin, 2003). Examples of those aspects are which curriculum components being discussed, what kind of difficulties teachers and school-leaders face in this task of developing a school programme, and the context in which decisions are being made. Such an approach is suitable whenever the research is focussed on on-going processes about which could be asked: "How did certain things happen and why?" and whenever the opportunities for studying this process are limited (Yin, 2003). In order to provide a valid and reliable picture of the process of developing a school programme, multiple methods will be used (Kelchtermans, 1999).

Cases were selected based on convenience sampling, due to limited options and time constraints. The three selected schools all differed with respect to one another in terms of the timing of other (planned) school developments with which this development cohered and in terms of the ambitions to integrate the programme into other (existing) curricula. Therefore, it resembled the purposes of a maximum variation approach in case selection (Miles & Huberman, 1994):

> School A (~1000 students) had not yet a programme for science and mathematics excellence for 11th-grade and 12th-grade VWO students. This school however was on the verge of developing a school-wide programme for excellence in upper secondary VWO, which is an extension of the lower secondary VWO programme already in existence in this school. Students participating in this programme get to do the first three grades in two years. At the start of this research, it was not yet clear what the exact ambitions were for the future programme of 'VWO sprint', as the programme is called and as will be referred to hereafter.
>
> School B (~1500 students) also has a special track for talented students in VWO. Those students get the opportunity to sign up for extra courses. One of these courses is natural sciences ('natuurwetenschappen') and at the start of the research it was already clear that most of the school programme for U-TA would be embedded in this course. The curriculum for this course was to be expanded as well for several grades. This development ambition coincided with the development of the formal curriculum for a school programme for U-TA.

School C (~1100 students, ~1800 students when other locations of the school community are included) on the other had already started implementing a science and mathematics talent programme for the upper secondary HAVO- and VWO-education at the time of the research, as well as in other subject areas. This school was on the verge of implementing a new educational concept, including differentiated class time.

All schools provide education on the levels of VMBOt, HAVO, and VWO.

## 3.2 Data collection

Workshops and one team meeting with the teachers were observed and interviews with the coordinator of the school programme were conducted. The length of studying each case, varied from two to three months for reasons of practicality and availability of both teachers and researcher. Below, the data measurement points are shown for all three schools (table 2), according to the method and time at which it was conducted. Also, a distinction between workshop- and meeting-observations is made therein, which will be further explained below.

Table 2 *Sequence of Research Activities within each Case-study*

| | **Week numbers** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| **School A** | WS | | M<br>I1 | | | | I2 | | | I3 | | | | |
| **School B** | WS | | | | I1 | | | | | I2 | | I3 | | |
| **School C** | | | | WS | | | | I1 | | | | I2 | | I3 |

*WS = Observed Workshop; M = Observed Meeting; I1-3 = Interview conducted with coordinator of U-TA.*

### Observations

Workshops were run in each participating school by an external facilitator from the university, concerning the aspects of the U-TA school programme. Those three-hour workshops were observed and videotaped. During these workshops the external facilitator clarified the basic principles of the future U-TA school programme (e.g. how students could be coached in doing their preparatory exercises for campus activities). Also, during workshop activities there was ample of opportunity for the teachers and school leader in the preparatory group to discuss and explain their ideas for the formal

curriculum to one another and to the external facilitator. Afterwards a report was written by the researcher, based on the observations made and the videotapes. Furthermore, the parts of the video-taped workshops that gave information on the decisions for the future programme were transcribed verbatim.

A subsequent team meeting of the preparatory group of school A was observed and videotaped. The meeting at school A had a length of roughly one-and-a-half hour. It was videotaped and transcribed verbatim. This observation has provided valuable data about the decision-making process and on how decisions are motivated by teachers as a team: 49 out of a total of 119 categorized statements stem from this one meeting.

School B had arranged a meeting after the period of investigation already had passed; therefore it is not part of the data collected. The team meeting in school C could not be attended by the researcher and therefore was only discussed in the interview. Observations of workshops and of the team meeting served to see how such decisions are made and how they are motivated, but it also provided the researcher with more insight into the context in which decisions are being made and the problems that teachers encounter in the process of developing a formal curriculum.

### Interviews

Three interviews were planned with the coordinator of the U-TA school programme at each school. Beforehand, teachers were informed about the aims of the interview; namely to gain insight into what decisions had been made at that school (goals, content, didactics/pedagogy and organization of the school programme for U-Talent), and also to get some extra information on the context in which the programme will be developed. The interview procedure was pilot-tested with a single teacher from another partner-school. Results of this interview led to questions being altered, as to make them less ambiguous.

During the interviews, questions were asked about the decision-making process, which parties were involved in the development of the programme and how. Next, questions were asked about what decisions had been made on content, didactics/pedagogy, and organization for each of the mandatory elements of the school programme. An example of a question: "What decisions on the organizational level have been made since the last interview about the future school projects for U-TA?" And: "What is the next step that you (the U-TA team) are planning to take regarding the school projects for U-TA?" After that, interviewees were asked to explain and motivate the decisions made. The whole protocol for the three interviews can be found in Appendix A.

Similar questions were asked in subsequent interviews to get an idea of the sequence of decision-making in the process and to obtain information about the context in which the decisions had been made. The last interview was a retrospective interview,

in order to look back on which decisions had been most important in the process of developing the U-TA school programme and what the prospects were on further development of that programme.

The approach used in this interview was that of an open interview, in order to allow for the interviewee to elaborate on the decisions being made. That way, it gave the interviewee the chance to express concerns, views, beliefs, and wishes regarding the curriculum.

The duration of the interviews varied from 25 to 50 minutes. Interviews were audio-recorded and transcribed verbatim.

## 3.3 Data-analysis

Data-analysis was carried out in two phases, which will be explained below.

### Phase 1: decisions about curriculum components

Data transcripts were read and re-read by the researcher in the first phase of data-analyses, in order to become familiar with the data. A coding scheme was established based on the 10 curriculum components as distinguished Van den Akker (2003). Codes were applied to relevant episodes. Not all statements about curriculum components made by teachers during the workshops, meeting, or interviews were marked as decisions. Those were mainly statements about current practice, of which it does not become clear whether or not it is part of the formal curriculum. Also, what became evident during the meeting, teachers sometimes put forward their own ideas that do not become part of the discussion and of which it does not become clear whether or not it is ever taken into consideration again.

During this phase of data-analysis, selected parts of interview transcripts were coded by a second coder. Afterwards similarities and differences in the coding were discussed until consensus was reached on the selecting and coding of crucial episodes. Thereafter the code-book was adjusted. The adapted code-book and another whole transcript were given to the second coder for a second round. Again, the outcomes were discussed between the researcher and second coder. When one had not marked something where the other had marked it as a relevant episode, it was often because it was a repetition of something said before in the interview. In other instances it was the case that the interviewee had only responded with a "yes". This form of confirmation was *not* to be interpreted as confirming that the statement by the interviewer was correct in every way possible.

Based on this process of coding, and on the discussion between researcher and second coder, an extra category was added. This included a code for decisions on the

development process itself. The code would be applied to statements made about the sequence of decision-making about curriculum components, or when teachers stated not to be concerned with components of the curriculum.

### Member-checking

In two cases (school A and B), the first phase of data-analysis led to a brief case-description in which the decisions on all four aspects of the school programme were summarized. Those were send to the interviewees for member-checking after the second or last interview. In the case of school A, this led to some additions and small alterations of the text made by the interviewee. In the case of school B, the interviewee had received the case-description just before the last interview but did not have any remarks on the case-description. School C was not involved in member-checking because of practical limitations.

## Phase 2: motivating decisions about curriculum components

After an inventory was made of the concrete decisions for the formal curriculum for each of the cases, transcripts were re-read to look for underpinnings of the decisions on any of the curriculum components. Four markers of quality considerations were used as categories for motivations given; i.e. 'relevance', 'consistency', 'expected practicality', and 'expected effectiveness' (based on Nieveen, 1997; 1999). The only two exceptions were the rationale and learning goals & aims, because those are often difficult to distinct from one another, and the rationale is in itself a motivation for other curricular decisions (i.e. motivations in the category 'relevance').

Within the category 'relevance', a distinction was made between relevance based on beliefs on what is relevant or on a rationale provided by external sources (e.g. when reference was made to information from the workshops). In the category 'consistency', a distinction was made between consistency between components of the curriculum for the U-TA school programme on the one hand, and consistency with preconditions of another programme on the other hand. This category was only applied when a teacher or school leader had motivated that a decision on one component was made to keep it consistent with another component. An additional sub-category of 'practicality' was invented: namely 'availability of resources'. This code was applied whenever a decision was motivated to be based on the (lack of) availability of resources.

The results of this coding phase revealed that in some cases there was no clear motivation given for specific substantive decisions. In some of those instances it was mentioned that the decision had been part of someone else's task (i.e. of another teacher or school leader). In other instances, no thought was paid to the decision, at least not during the meeting or interview; those were put in a residual category.

Using one interview from case A, fragments were selected in which an argumentations was recognized. These fragments, together with the codebook, were presented to the same second coder. After separately coding the fragments, outcomes were discussed between researcher and second coder until consensus was reached. The codebook needed small adaptations after this. A third coder was then instructed to use the codebook as described in Appendix C, and to assign a code to 62 selected quotes. Those quotes stemmed from the interview- and workshop transcripts in two different cases, from a total of 118 quotes. Discussion afterwards led to improvement of the (use of) the codebook.

A couple of motivations given for a single decision are shown below (Table 3), categorized under either 'relevance', 'expected practicality', or 'expected effectiveness'. The examples given are all related to the decisions to incorporate multiple school subject-disciplines into single school projects.

Table 3 *Examples of Quotes as Categorized under one of Nieveen's (1997; 1999) Quality Considerations*

| Quality marker | Applied when: | Example of quote |
|---|---|---|
| Relevance | Decisions are based on state-of-the art knowledge. | 'What appeals to me about this school subject, is that is interdisciplinary for the most part, I personally believe that adds value'.<br><br>And<br><br>'These are the students who will probably end up doing research; they are talented […] so it is not at all strange to offer them these extras'. |
| (expected) Practicality | The decision meets the needs, wishes, and contextual constraints of the teachers and students; teachers consider it usable; it is easy to use materials in a way that is largely compatible with the developer's intentions. | 'It is healthy for students to look across the borders of individual school subjects, and that is what happens'.<br><br>And<br><br>'They [the students] can handle it'. |
| (expected) Effectiveness | It is expected that students appreciate the learning program and that desired learning takes place. | '[…] because it is good for their learning process […]. |

## 4. Results

In the following section, results on the substantive decisions made for the U-Talent Academy school programme will be presented one case at a time. The focus will be on school projects in order to limit the length of this section, and as this was the one required aspect for the school programme that received most attention by the U-TA

team. This can be illustrated by taking the total number of decisions about all individual curriculum components and subtracting the total number of decisions that are specifically *not* related to the school projects (Table 4).

Table 4 *Total Number of Decisions about School Projects in Comparison with the Total Number of Decisions Not Concerning School Projects*

| Case | Decisions about school projects (#) | Decisions *not* about school projects (#) |
|---|---|---|
| School A | 32 | 10 |
| School B | 31 | 11 |
| School C | 37 | 19 |

Thus, school projects were discussed more extensively during interviews in comparison to the other aspects of the school programme; i.e. forming a learning community, preparatory- and concluding activities for the campus programme, and differentiation between students. As can be seen in Figure 2, school B had slightly more decisions categorized under 'goals & aims, content, and assessment' and 'didactics', compared to school A and C. The 'Results' section below will give a short account on the decisions made in each category, and in the 'Conclusions and discussion' section, the differences in the focus on categories between cases will be explained.

The reason why the teachers discussed this topic more extensively during meeting and interviews, and why most decisions made were about this aspect of the school programme, will be discussed in the 'Conclusions and discussion' section.

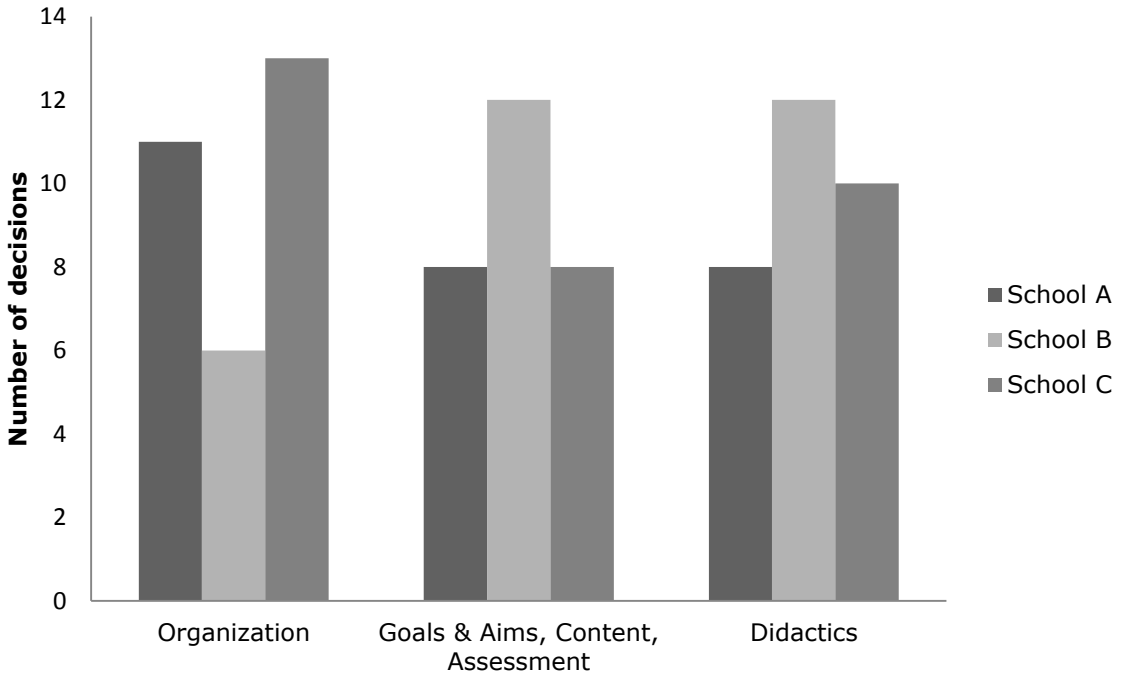


Figure 2 *The Number of Decisions Made in Each Case About Curriculum Components Concerning School Projects, as Categorized by Organization (including 'grouping', 'time', and 'place'); Goals & Aims, Content, Assessment; and Didactics (including 'learning activities', 'teacher role', and 'learning materials')*

The decisions and their motivations are structured according to the curricular spider web (Van den Akker, 2003; Thijs & Van den Akker, 2009), categorized into the following paragraphs:

**organization of the school projects**, including components 'time', 'place', and 'grouping';
**goals & aims, content, and assessment**;
**didactic design of the school projects**, including components 'learning activities', 'teacher role', and 'materials'

Quality markers as described by Nieveen (1997; 1999) are used to denote the kind of motivations given for decisions on the school programme.

Before moving on to the substantive decisions and their justifications, a brief outline of the starting situation will be given for each case. This is deemed important as it partly explains the lack of decisions made on some aspects and components of the curriculum.

## 4.1. Decisions about the formal curriculum in school A

At the time of the workshops, it became evident that there were other developments going on in the school with which the school programme of U-TA would be linked. There were ideas for designing a school-wide programme for excellence ('sprint VWO') in upper secondary VWO education, to be started next school year in grade 9 of VWO, however this was not necessarily for the U-TA team to be concerned with, but for the teachers and school leaders involved in the 'sprint-team'.

There were no concrete ideas for this programme at the time of the workshops, and still not at the time of the time of the subsequent U-TA team meeting that was observed by the researcher in this study. In the team meeting, the teachers involved expressed their ambitions to embed the future 'sprint VWO' (the part for science- and mathematics subjects) in the U-TA school programme. The teachers thereby wished to maintain the possibility to include students from both regular- and sprint VWO.

Also, the currently existing HAVO talent programme was to be included in the school programme for U-TA. This programme has started in the same school year as when the research was conducted, and it offers talented HAVO students the opportunity to engage in extracurricular activities. Those students participating are in a project class roughly one half day on a weekly basis, because of which they miss some regular classes.

### Organization of school projects

The main focus of the teachers when talking about school projects, was on the organization, i.e. time, place, and grouping on the school-level. Less attention was paid on content, learning aims and goals, teacher roles, materials & resources, and assessment for the new curriculum.

The main starting points for decision-making on the organization for the U-TA team during the meeting were (1) to offer students from both tracks in VWO the chance to participate in U-TA, and (2) to have an organizational framework in which both the U-TA- and future sprint-programme could be fitted. This meant that preconditions for the sprint programme, although not all clear to the U-TA team, were taken into consideration as well. Those preconditions for sprint VWO were mainly put forward by the math teacher, who reminded the other teachers of the current practice and organization of sprint in lower secondary VWO-education. Decisions which are motivated to meet up to those preconditions, were thus categorized under the quality marker *consistency*. For example, when talking about the sprint programme in lower secondary education, the math teacher says as follows:

> Then you would want to take things from the standard curriculum, and offer that [to students] in another way. So you put subject matter of specific school subjects into a school project and let them execute that. *Math teacher, meeting.*

However the U/TA team first and foremost focussed on an idea for scheduling a weekly 'project class' and thereby took into consideration how the future track of 'sprint VWO' could be embedded therein and its consequences for the standard curriculum of science and mathematics. In this science project class, students from HAVO (years 10 and 11) and VWO (years 10-12) will be grouped into one programme of science and mathematics excellence. Those students will have less regular classes in science- and mathematics.

First of all, the science coordinator thought of the project-class as a means to differentiate between students (*expected practicality*). Next, the U-TA team saw this as a fit solution; when discussing the idea of a project-class they took into account limited availability of money and teachers (*availability of resources*), and the wish to include students from both sprint VWO and regular VWO (*relevance*). Also, it was motivated (in hindsight) that grouping HAVO- and VWO-students would be helpful in stimulating the forming of a learning community (*expected effectiveness*). Furthermore, it was explained by the coordinator that this way, it would be possible to embed the existing programme for science excellence for HAVO in the overarching school programme for science- and mathematics excellence (*expected practicality*).

Consequences for the time table of the regular classes and were up for discussion, as the U-TA team had decided that one out of every three regular science- and mathematics classes would be exchanged for time to be spend in the science project class. Thus, students in the U-TA school programme will miss regular classes on a weekly basis.

Furthermore, the number of students participating in the science project class may vary according to what the U-TA team had decided during the meeting. They then realized that the criteria for participation needed careful consideration. Therefore, teachers decided that students' motivation for participation in combination with students' previous achievements in science subjects and projects should be assessed.

### Goals & aims, content, and assessment

Goals and aims are mainly about students' attitude concerning the overall programme for U-TA, for example the coordinator mentioned in the last interview that students should 'feel privileged' and 'excited to participate' in this programme. Other, more specific goals for school projects have not become evident.

At the time of the workshops, the team leader of VWO already had plans for a school project to start with in the school programme for U-TA. This module (NLT) includes the use of the subject informatics. The U-TA team saw the use of the subject informatics as a *relevant* addition to the school projects in terms of it being used almost in every study, and in supporting students in solving problems in their projects (*expected practicality*).

Next to that, the teachers had agreed during the meeting that each school project for the project classes should cover multiple disciplines, although they did not motivate this at the time. Instead, when asked to motivate this decision in interview 1, the coordinator argued that working on interdisciplinary projects offers a more realistic image of how natural sciences fit together/work (*expected effectiveness*), that this is how is being worked in research (*relevance*), and that it could be very inspiring for students (*expected effectiveness*) to see that individual disciplines support each other (*expected practicality*).

It was discussed during the meeting that projects should fit with the interests and experiential world of the students. Between interview 2 and -3, such possible themes for future projects had been discussed by the U-TA team. When the interviewee was asked to elaborate on one or two of those themes, she mentioned that the theme 'life in outer space' could really work as an interdisciplinary project. She said that they expect this theme to fit students' interests (*relevance*). Another possible theme mentioned was 'science-fiction-like things,' the interviewee thought students hereby would be challenged to explore the frontiers of science (*expected effectiveness*). She also said that science fiction can become reality after some time, hinting at more decision-making based on relevance of themes for projects.

During the meeting and interviews, there was less focus on the curriculum component 'assessment'; this was only described in vague terms, that '[…] it will be assessed' (referring to school projects).

### Didactic design

When in the meeting plans were discussed to use teaching modules from 'NLT' (Nature, Life, and Technology)[4] for school projects, the U-TA team had agreed to make the learning materials more open-ended. This was to make them more compatible to the level required from students (*relevance*).

Furthermore, grouping HAVO- and VWO-students in the same project class requires the students to work independently on their projects and without classroom instruction by the teacher (*consistency*). Instead, teacher shall give one on one feedback to students.

[4] 'Natuur, Leven en Teachniek' is an interdisciplinary subject offered in many Dutch secondary schools.

In the last interview the teacher explained that HAVO- and VWO-students participating in the science project class will be working on the same topics as well. First of all this was done from reasons of *practicality* (i.e. '[…] so students can benefit from the results of other students'). Secondly, the interviewee explained that she and her colleagues concluded in hindsight that by working on the same topics, the forming of a learning community would be stimulated as well (*expected effectiveness*).

Many decisions regarding the structure of school projects are adopted from the existing 'sprint programme' and in that case, often consistency was being considered as a quality marker. For instance, the need for subject-specific projects was brought forward by the math teacher, who explained that it is common for sprint VWO to have students work through (at least parts of) the standard curriculum in the form of projects (*relevance*). Also, a pedagogical concept that is currently being used in the existing track for the lower secondary VWO-education, 'top-down teaching', will be adopted for the structure of the school projects.

### Process of curriculum development

A couple of weeks after the workshops, a meeting was scheduled (including three teachers and the coordinator of U-TA school programme). The team meeting was specifically about the U-TA school programme.

It became evident in this meeting that the U-TA team (among which were teachers from the sprint team) had a lack of clarity on the future form of the 'sprint programme' for years 10, 11, and 12. The U-TA team wished to design one organizational framework in which both programmes could be included; thereby they saw the need to take into account the requirements for both the sprint programme and the school programme for U-TA. Therefore, matters of consistency that were discussed at the time, often related to the preconditions as known from the existing sprint programme in lower VWO education.

There was less time for focus on the content of the school programme at that time. This seems to have been a conscious decision, as the coordinator concluded in the meeting:

> [S]o we can conclude about developing content: that is not yet to be addressed, because we need a substantive framework first […]. *Coordinator, meeting*

Somewhere between the meeting and second interview, there had been a meeting about the organization for this sprint programme, involving teachers and school leaders of the 'sprint-team'. This resulted in more clarity on the future ambitions and the

organization of both programmes for the U-TA team. The teachers became more concerned with the content of the programme for U-TA from that moment onwards.

Furthermore, the interviewee had mentioned that the school leader increasingly delegated tasks to the teachers (on a positive note), and thereby facilitated the U-TA team. Embedding the programme in the organization and forming a learning community were part of the responsibilities of the school leader and the VWO team leader, whereas the teachers should be more concerned with designing the school projects. The project to begin the programme with, had already been selected by the team leader of VWO; she was most concerned with adapting learning/teaching materials for this particular project, whereas the U-TA team was still brainstorming on other themes for future projects.

## 4.2 Decisions about the formal curriculum in school B

This school has a special track within VWO education called 'VWO plus', which offers students extra school subjects on top of the standard curriculum/regular classes, between which they get to choose to participate in. One of these school-specific subjects is called 'natural sciences', and this subject was offered in upper VWO education. Because of the small number of students participating in this school subject, students from year 11 and 12 are grouped.

There were already plans to extend this programme, and to include other years as well. At the time of the workshops, it became evident that school projects for U-TA were to be embedded into the programme of natural sciences. The math teacher was most concerned with developing the subject of natural science and was the one teaching it in year 11 and 12 of VWO. Therefore, he was the one interviewed as coordinator of the U-TA school programme.

### Process of curriculum development

During the course of the research, the coordinator was mainly busy with selecting and adapting materials for future projects for the students. Selecting and adapting materials was a time-consuming activity, according to him. The math teacher and the school leader involved discussed the overall goals and aims for the school subject, as well as other matters of organization of the subject of natural sciences.

The coordinator wanted his colleagues from the NLT teacher team to become more involved in developing projects for natural sciences, and eventually be part of the implementation of school projects in natural sciences. He said he needed to activate them in order to accomplish that; a process that had only started right before the last interview. At the time of the workshops, it had become clear that those colleagues are used to working together.

### Organization of school projects

One of the main reasons for organizing school projects for U-TA within natural sciences, was to meet the wishes to offer the students 'extras' in this school subject, to have students working independently, and to have them delve into science- and mathematics (*expected practicality*), but also for the sake of limiting organizational changes to one subject (*availability of resources*). The coordinator mentioned that students are used to work on projects in this course, so school projects for U-TA could be embedded (*consistency*). All students participating in natural sciences will be participating in the school programme for U-TA, thus working on the school projects in this case. Because of the small number of students enrolled in natural sciences, students from year 11 and 12 are grouped in these classes.

### Goals & aims, content, and assessment

The overall goals for the school programme of natural sciences and U-TA, as well as the requirements concerning the school programme for U-TA, were discussed between the interviewee and the school leader. Thus, at the time of the second interview the overall goals of both programmes were: (1) to get an idea of what encompasses natural sciences, (2) to gain academic thinking/learning skills, and (3) to come into contact with the academic world. Thereby a learning trajectory for developing research skills ensures vertical coherence in the programme for natural sciences. Natural sciences furthermore aims for students to gain more in-depth knowledge across all scientific areas in natural sciences, as opposed to the broader but less in-depth knowledge offered in the school subject NLT.

The coordinator mentioned his preference to put tasks into some historical context. Herein he refers to both beliefs on the need to offer general knowledge (*relevance*), and on how it enables himself to teach in an enthusiastic manner (*expected practicality*), and even hints at *expected effectiveness*, as he mentions 'broadening horizons' (although not in a full sentence):

> Historical version […] that may be my personal preference [originally: 'afwijking'] […] I think that […] education is not just about teaching all kinds of skills, but you should also offer some general knowledge […]. And well, I find it interesting personally, and if you find something interesting, then you are able to transmit it more enthusiastically, so. I find it fun to offer it in that [historical] context as well, and then they [students] do look beyond… natural sciences have their origins

> somewhere… broadening horizons. So yeah, there is no real didactical idea to it, no, it is more of a pedagogical one […]. *Coordinator, interview 1*

The same as in school A, there is a preference for interdisciplinary school projects, although mono-disciplinary projects were also considered as possible, depending on the interests of students (*relevance*). Thereby, the coordinator referred to students who had previously been working on a project about quantum mechanics as they were interested in theoretical physics, and how these students had been busy trying to understand the underlying theory (*effectiveness*).

According to the interviewee, interdisciplinary projects are *relevant* with this particular group of students, as is illustrated by the following quote:

> These students are the ones who will probably end up doing research in this area [of science], and get a job there. They are also talented, so maybe it is not that strange to offer them all these extras, because they can handle it. […] Not just because it is good for their learning process, but because these are the students who can manage it in terms of attitude and intelligence. […] *Coordinator, interview 1*

Other arguments for the use of interdisciplinary projects the coordinator gives, are that it adds value to the course (since projects situated in only one of the science- or mathematics disciplines might as well be part of the standard curriculum), and that students with different talents (i.e. in physics or in biology) should be enabled to use these talents (*expected practicality*).

The project that the coordinator had selected for his students to begin with was themed 'world hunger'. It was said to be an 'appealing topic', but he does not explain for whom it is appealing. Later on mentions it to be 'a real world' topic, and that therefore it is no coincidence that this project involves multiple disciplines, as real-world topics often involve more than one scientific discipline. The teacher moreover said he thought this lesson series was in line with what is required by U-TA, as '[…] it really fits well as a project with what […] U-Talent requires from schools, about what to do with content topics.' However, it does not become clear from the interview transcripts what and how it is exactly in line with U-Talent. He then mentioned that students would be working with materials like vitamins, making this project more realistic. However he added that it was not a criteria as he would also use materials for projects in which specific focus is on one scientific discipline.

However, first of all the coordinator mentioned that this project was something that happened to be available (*availability of resources*):

> '[…] Yeah and then there are, that's as easy as it is too, sometimes things happen to cross your path. So what I plan to do in year 11 and 12 of VWO, next year, and I still need to delve into it, is to offer a series of lessons to the students, about world hunger, an appealing topic […]. And a colleague of mine […] an economy teacher, he was the writer of this series of lessons together with […] an associate professor […].' *Coordinator, interview 2*

### Didactic design

The coordinator mentioned in the first interview that students must keep a degree of choice between projects within different scientific disciplines, adding to that that there will be differentiation according to students' interests (*relevance*).

Also important in the subject of natural science, according to the coordinator, is that students work independently from the teacher in terms of formulating their own research questions within projects and decision-making in how to answer these. The role of the teacher will be to coach students on the level of process and sometimes direct them into choosing between projects.

For the first school project, plans were to divide the whole group into three sub-groups, and that each will approach the topic from another perspective (i.e. chemistry, biology, physics), and that at the end of the project the students will present to one another and then all perspectives must become integrated. He motivated that by integrating the different perspectives, research skills are an important part of the activity, and makes 'it' interdisciplinary; which were earlier mentioned decisions for the school projects (*consistency*). Also he mentions that, by means of grouping students according to the different perspectives, students get a choice (*expected practicality*).

The coordinator said to have adopted the structure for school projects from the workshops, e.g. in terms of required skills and learning activities being open-ended, to those of the campus programme of U-TA in order to create coherence between both programmes (*consistency; relevance*). More specifically, this means that projects will be initiated with guided tasks, followed by open-ended tasks, and finally students will give a presentation about their work whereupon the teacher asks them questions. The coordinator motivated this at the time of the workshops as increasing students' curiosity (*expected effectiveness*), and to introduce a new topic to students and enabling them to formulate their own research questions (*expected practicality*). In the second interview, the teacher mentioned the idea to have students give a presentation in front of different audiences, e.g. their parents or students from lower secondary education, so that those students may become enthusiastic about the programme (*expected effectiveness*). The teacher explained that students will be assessed on both presentation skills, as is also

assessed in other school subjects (*consistency*), and on the content of the presentation (e.g. whether or not it was enough in-depth) (*relevance*).

Also, the coordinator wanted to involve some of his colleagues in constructing- and teaching of projects, because of their expertise knowledge. He furthermore wanted some of his NLT-colleagues to be available during classes of natural sciences; in later interviews he motivated this as enabling students to ask content-related questions (*expected practicality*). Later on, he said to expect that the active involvement of more teachers could help in forming a learning community (*expected effectiveness*). However, the following quotes illustrates that this last motivation had not been considered by the coordinator, when deciding to get other teachers involved:

> I think that […] 'community' [laughing] still is a thing I do not do anything with, with which I do not have any affinity, so, er, to me it is not decided from that point of view. But er, yes, the thought of going through a process together and having more teachers involved [in that process], and that students know, thus become familiar with: 'oh I can also go to that person, he/she thinks along with me.' That idea appeals to me; it makes it more fun […]. *Coordinator, interview 3*

Other activities outside of natural sciences-classes mentioned, were those in the 'project days', focussed on one or more science subjects at the same time. The teacher said he especially valued the application of knowledge that happened on such days (*relevance*).

## 4.3 Decisions about the formal curriculum in school C

In this school, a lot of school-wide changes in education are about to occur. In the school year at the time of the study being conducted, talent programmes across several different subject areas had had their spin-off. This included a science- and mathematics talent programme, in which a small group of year-10 students from HAVO and VWO had started, together with some year-11 students from VWO. This programme was to include the U-TA school programme, as became evident during the workshops.

At the same time, the school was being prepared for big changes in its educational concept. According to this concept, differentiation between students will take place on the level of scheduling extra classes according to their needs for extra exercise- and/or in-depth assignments in one school subject or another. This new concept requires teachers to plan their regular curriculum taking into account the different types of classes as well (i.e. classes for basic instruction/regular curriculum vs. classes for differentiation

in level of assignments offered to students).

### Organization of school projects

During the workshops it was mentioned that the school programme for U-TA is to be embedded in the existing science talent programme this school offers, which had started in the current year. This science and mathematics talent programme includes a group of talented 10th-grade and a couple of 11$^{th}$-grade students, and the idea is to have year 10-12 VWO-students and year 10-11 HAVO-students participating in it, eventually. The biology teacher being interviewed is coordinator of this talent programme, as well as education coordinator.

Many decisions regarding the organization, were related to the new educational concept including differentiation between classes. The new to-be-developed time tables for science and mathematics subjects, offered the U-TA team the opportunity to schedule a weekly 70 minute class for the talent programme (i.e. 'talent class'). Students will be working on their school projects during those classes, among other activities that will be part of the programme. This organization was motivated by the coordinator at the time of the workshops: that indeed a lot of arrangements with students needed to be made (*consistency*), and that this it would be difficult to accomplish otherwise (*expected practicality*). In interview 2, she also expressed her belief that this many changes in education may be difficult to handle for some, thus organizing a this talent-class would be better for those students (*expected practicality*).

Another way the organization for this talent class might be motivated, is by the new educational concept. This concept includes special classes for science and mathematics-subjects, between which students have to choose and sign themselves up. They will do this according to their needs for extra practice, or if they are talented enough, for extra in-depth assignments. The coordinator mentioned during the workshops that students in the talent programme specifically are required to work on school projects during the talent class, as she expressed her concern: '[…] You don't want to have six/seven talented students asking you all kinds of extras, during your [other] extra classes, because then you will not be able to give extra guidance to those students who really need it.' (*expected practicality*). Thus, both teachers and students are expected to benefit from having a talent class.

However, in later interviews it was mentioned that students working on their school projects, may sign up for extra classes according to what the project is about (e.g. a lot of physics, or chemistry) (*expected practicality*).

### Goals & aims, content, and assessment

The overall goals of the science talent programme are mainly related to attitude (e.g. 'students should feel appreciated and be proud of themselves' – coordinator, interview 1), and to focus on possibilities in future science- and mathematics-related education. Other aims mentioned were related to strengthen the existing learning community of talented students and the image of science and mathematics.

Specific goals for school projects became less evident during observations and interviews. However, it should be mentioned that the interviewee did not have complete overview over all projects being developed at the time. In the school project that was piloted at the time of the research, the focus had been mostly on developing practical skills.

School projects were said to contain broadening and/or enriching learning activities, and that topics will be situated in one of the science- and mathematics disciplines. Some of the criteria mentioned for the school projects are related to national criteria for future approaches in science and mathematics education, i.e. concept-context and problem-based (*relevance; consistency*).

It was mentioned that students should be offered a choice between school projects between projects; thereby the talent coordinator had suggested having the choice limited to two disciplines every time:

> It is just like you [referring to colleagues] just said, that 'well, maybe we need to tell students at some point: you have a choice, but you need to choose for example between biology and chemistry this time, and next time you need to choose between mathematics and physics,' because then each time, other students will be the better performers of the group. Because for some students it can also be challenging to really need to work for it […]. I think it will be really more fun for the students to need to work […] I personally got the impression that the image of the science talent group has become more positive. *Coordinator, workshop*

The end-product of school projects is to be in the form of a presentation. This is not only to assess the work of the students, but also to inform future participants in the talent programme (*expected practicality*). The project-presentations will be assessed using existing criteria (i.e. as used for the VWO cluster-project), however more details about assessment were to be discussed *after* the last interview was conducted.

### Didactic design

The interviewee emphasized the importance of having students work in groups of two to three students: she0 expected it to result in the students looking more critically at

their own work (*expected practicality*) and in resulting in more substance to their own work (*expected effectiveness*).

Aside from the projects on which students will work during talent classes, a variety of activities for the talent programme were mentioned in the course of the workshop and interviews, i.e. practicums and excursions are also to be included in the talent programme. Those excursions could become part of the school projects, and were motivated to stimulate the forming of a learning community (*expected effectiveness).* The coordinator thereby often referred to her experiences with the talent programme. Multiple sources and materials will be used for this programme, including the electronic learning environment; that the coordinator wants to use more extensively, e.g. for creating portfolios for students. This she wants to ensure that students chose different kinds of projects, thereby covering all disciplines, arguing that the learning materials should cover more (*relevance*).

The independency of students in the talent programme was emphasized more than once during the interviews. The assignments yet to be constructed should enable students to work independently from the teacher for the most part. This was partly motivated by the new educational concept, as now students from different levels and years will be mixed in extra classes (*consistency; expected practicality*).

Other teacher roles mentioned were to (flexibly) coach the U-TA students in the science talent class and guiding them in choosing between projects and in scheduling extra classes. Teachers' knowledge expertise was still found to be desirable as is illustrated by the following quote:

> I personally believe that the process is always dramatic when you [as a teacher] do not know what it [the assignment] is all about. For students, that is not at all motivating, if you cannot discuss topics with them. *Coordinator, interview 2*

The idea to have multiple teachers coach the students during talent classes was motivated by the interviewee as enabling the teachers to help each other out; something they thought of as necessary at the start of the programme (expected practicality). Also, the coordinator mentioned this way, it would be ensured that students could be helped with their projects and campus-assignments. Much earlier, during the workshops, the coordinator had said that she believed it necessary to have more than one teacher involved with the students in the talent programme (e.g. with joining on excursions), as this would stimulate a sense of team spirit (*expected effectiveness*).

Regarding assessment of the projects one of the coordinators' ideas is to have the students present their final product in front of talented students from their partner school

in this regional collaboration. In motivating this decision, she referred to relevance, expected practicality and –effectiveness (based on her experience) as follows:

> […] I have been noticing that some of those talented students benefit from having someone else counteracting them once in a while ['tegengas'], because they are of course always the smartest of the group, they always know better, and some are quite stubborn. Therefore, it is not at all a bad idea to have them meet other people who are of the same level as they are; then they are not always the smartest around. Yeah, I really support that [laughing]. *Talent coordinator, interview 2*

### Process of curriculum development

At the time of the workshops, it became clear that a lot of construction of learning materials still needed to be done; not just for the students in the U-TA school programme, but also for other students, as a consequence of the new educational concept in this school. Selecting and constructing materials turned out to be a time-intensive task for the teachers involved. Some assignments (to be used for next years' school projects) were scheduled to be piloted before summer. At the second interview the coordinator mentioned that not all materials had been made ready in time for this pilot.

After the second interview, a meeting with the U-TA team was scheduled in which the coordinator got to divide tasks among teachers in this team. There, it was decided to continue developing and constructing learning materials with a smaller group of teachers: one from each discipline, including informatics and mathematics. Furthermore, the U-TA team had agreed to use learning materials from NLT-modules for school projects. As there still were some projects to be developed, the number of projects to begin with will be limited. Plans for the future were to offer the students the possibility to choose between topics; this will thus not be the case at the start of the U-TA programme (yet). Up until that meeting, the coordinator had been the one mostly concerned with developing and implementing the talent programme. Now she had asked a few colleagues to also coach students in the talent class. This was a topic still up for discussion at the time of the exit-interview, as well as assessment of the school projects and the decision-making on other activities for the talent programme.

## 5. Conclusions and discussion

The aim of this article is to contribute to knowledge of teachers' curriculum decision-making in the process of developing a formal curriculum. Therefore, three case-

studies were conducted in schools that were part of a regional school-university initiative, to develop a school programme for science and mathematics excellence. The research question central in these case-studies was:

> What decisions do teachers make about curriculum components for the school programme in the process of developing a formal curriculum, and how are these motivated?

The overall direction of the results show that the organization of the curriculum; i.e. 'time', 'place', and 'grouping' (on the school-level), are the first of curriculum components on which is being decided. Therein, local context (i.e. how it is to cohere with other developments within the school and what kind of organizational structure already is there) is seen to be used as a starting point. Also, I argue that those local contexts determine to a large extend how curriculum decisions are made and are motivated by teachers and how this shapes the formal curriculum of a school programme for talented students. I will present conclusions on the decision-making on the school projects for U-Talent Academy in the three school in this study, together with the influence of the local context below:

### Organization for school projects

In case A, most focus of the U-TA team was on the future organization of both the school programme for U-TA and for sprint VWO. This became especially evident during the meeting, as the team lacked an organizational framework for the school projects. Handelzalts (2009) found that the curriculum components 'time' and 'place' were the most prominently discussed curriculum components in development discussions of teacher design teams (TDTs) across different school subject areas. At the same time, he also concludes: "The clearer the reform ambitions of the TDT were and the better the overview of the process was, the less conditional Time and Place became for their work." (Handelzalts, 2009, p. 87). This is furthermore supported by the findings of Nieveen et al. (2011), who studied teacher teams that were about to develop a more coherent school curriculum for lower secondary education. She found that teacher teams with a lack of insight into the relationship between parallel innovations planned in their school, made it difficult for them to concretise, by lacking a framework for the reform (Nieveen et al., 2011). This might explain why limited decisions about substantive matters of the school projects were made until later in the period of research in school A.

However, the fact that the programme to be developed for sprint VWO was building on a programme for ´sprint´ in lower secondary education in this school, may have helped the U-TA team to come up with a solution for the initial lack of an

organizational framework. In discussing the organization, many decisions about have been motivated as to enable both students from sprint VWO and regular VWO to participate in the school projects, and in meeting up to the (possible) requirements for the future sprint VWO programme. Also, they were able to take into account some of the contextual constraints into the organizational framework, of which the teachers were well aware.

Decisions about the organization are mostly made out of practicality considerations. Although teachers in case A talked about creating alternatives for talented students to work on school projects as a substitute for regular classes in school subjects, a projects class with extracurricular subject matter (i.e. interdisciplinary projects), was a more feasible option to them. The same holds for case C, where having a separate class for the school projects (among other activities) was said to keep organizational matters clear for both participating students and teachers. It was found that such organization-related decisions, like grouping students on the school-level, are also motivated by their expected effectiveness in hindsight, e.g. in terms of positive effects on the learning community.

### Content of school projects

Other interesting commonalities found in decisions regarding content of the school projects, are that teachers find it necessary that several school projects together cover all disciplines in science- and mathematics school-subjects. In cases A and B, the coordinators intend to attain this by the use of interdisciplinary projects. The motivations given for the choice of interdisciplinary projects in terms of it being relevant, was noticed to differ between teachers, although both in case A and B it was said that interdisciplinary projects are 'added value' to the school programme. Thereby, in case A is referred to subject characteristics, whereas in case B, the coordinator also referred to relevance in terms of student characteristics.

### Focus on selection and adaptation of learning materials – less focus on specific learning goals & aims

A lot of focus was on the selection and adaptations of materials for school projects as for example is applied on campus projects (school B). This immediately explains why less attention is paid to the other aspects required for the school programme, as school projects are more easily concretized.

Selecting and constructing learning activities overall is a time-consuming activity that teachers were mostly concerned with at the time of the research, aside from organizational matters. Thereby, specific (learning) goals and -aims in school projects, seemed to be more or less dependent on the modules being selected (e.g. NLT), and those goals and aims almost never became evident during observations and interviews.

It seemed that selection of materials for school projects was mainly done based their availability, and next based on the topics of the projects. Topics and themes of materials were motivated by complying to criteria like 'offering challenge to students', 'being interdisciplinary', 'providing opportunities for in-depth learning', and 'being appealing topics and/or matching students interests'.

Specific learning goals and aims of school projects, was less of a point of focus in school A and C, as was the case for school B. In school B, the overall goals and aims of the school subject 'natural sciences' were discussed between the coordinator en school leader as a result of the programme for this school subject being extended. School A and C however did not have the school subjects embedded in any one specific school subject, and may therefore have focussed more on matters of organization, at the cost of discussion on coherence between school projects in terms of learning aims and goals (especially in school A). Or if they did discuss those matters in detail, it did not become evident during the observations and interviews, but it is also possible that they became concerned with specific learning goals and aims only later in the process of curriculum development.

Thus, the fact that the coordinator in case B was concerned with the overall structure of the school subject of natural science, and therein the school projects, plus the fact that he was experimenting with- and constructing the materials mostly by himself at the time, may explain why more decisions on substantive aspects became evident during interviews. Also, the less need to focus on the curricular components of 'time' and 'place' for the whole programme, may explain why the focus in case B was more on substantive principles of school projects.

To what end learning materials for school projects are adapted in all cases, also reflects the differences in focus on organization and/or content- and didactics of the school projects is also seen. Again, the influence of the local context is evident therein, as for example in school C it was emphasized that learning materials should facilitate students in working independently from the teacher. This is consistent with the fact that students from different years and levels will be grouped on the school-level; not just in the talent class, but also in other classes for which extra exercises are being developed according to the new educational concept in school C.

### Implications and recommendations for further research

The finding that there is less focus on coherence between school projects in school A and C, may be due to limited knowledge on the development activities in both schools or because these schools were simply at a different stage in the process of developing school projects (e.g. a team meeting was scheduled for the end of the school year in school C to address matters like assessment). However, it might be related to the primary focus being on the organization of the school programme, and on collecting of

topics and materials for school projects. Handelzalts (2009) warns that '[d]ivision of the construction tasks increased the 'speed' and production in the development process but often led to less collaboration and alignment.' (Handelzalts, 2009, p.95).

All interviewees mentioned that the teacher role in relation to the students participating in the school projects would be that of coaching students and guiding on the level of process. A seemingly contradiction with those findings, is the wish expressed by all teachers to be well-informed on the contents of the projects. Coenders (2010) found in a study on the assessment of teachers' beliefs about a new didactical approach in chemistry education, that although teachers (cautiously) approved of this new approach, they did not have a clear picture about the implications of this innovation for students learning. The same may count for teachers in the cases studied here; they still may not have a clear idea on the effects of a different teacher role in the school projects on students' learning, although they support the ideal curriculum. Also, de Kock et al. (2005) found that teachers planning classroom practice according to reform, often incorporate curriculum components that are associated with more traditional roles. This might also be the case here.

Other teachers' efforts in constructing school projects were left underexposed during interviews, as the interviewees were not the (only) ones concerned with constructing the materials for the school projects. Interviewing more teachers within one school would provide more details on the decisions regarding the formal curriculum. On the other hand, the fact that interviewees did not address those curriculum components by themselves during interviews, may say something about those components appearing as relevant to them in that stage of curriculum development. It could be that aims and goals for example, only start becoming relevant to be concerned with, after teachers have clarity on the organizational framework, as well as on their own specific tasks in the development of school projects.

In future research, more information may be gained from individual teachers for their curriculum plans. Teachers may be prompted to talk about more components of the curriculum, when provided with concrete curriculum materials during the interview (Handelzalts, 2009). Thereby more questions focussed on *how* the teacher plans to implement the school projects, e.g. in terms of the learning environment and the interpersonal teacher roles. This should be a relevant addition to interview protocol, as de Kock et al. (2005) found that only a few teachers being interviewed would explicate such curriculum components by themselves, but that they would stress the importance of these components as soon as being asked about.

Observations of a meeting proved to be a valuable addition to the data collection in this research: the more pressing matters were expressed there, whereupon decisions

were made. Also, the approach of an open-ended interview with only one teacher provided the researcher with other concerns that did not become evident during team meetings. Combining both observations of team meetings and interviews also enabled to make a distinction between justifications given for decisions in hindsight and the actual quality considerations upon which decisions were made at the time.

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# Appendix A

Interview scheme (Dutch)

**Introduceren van het interview. Toestemming vragen voor het maken van geluidsopname:**

- *Opbouw van het interview: informatie over de geïnterviewde en over de stuurgroep; de context waarbinnen het schoolprogramma vormgegeven wordt; de inhoud van het schoolprogramma.*
- *Geen antwoord kunnen geven op een vraag kan, geef dan aan wie dit mogelijk wel weet.*
- *Geluidsopname en verwerking van het interview.*
- *Duur van het interview: ±40 minuten*
- *Toestemming vragen.*

**Informatie vooraf:** *Only in the first interview*

**Karakteristieken van de stuurgroep (1e interview)**

Hoe is deze stuurgroep tot stand gekomen?

Heeft eerder (een dergelijke) samenwerking plaatsgevonden tussen deze docenten?

Welke taken zijn er verdeeld onder de leden van deze stuurgroep?

Welke rol speel jij zelf binnen de stuurgroep?

**Aanpak (1e interview)**

Wie is verantwoordelijk (geweest) voor het uitstippelen van een plan van aanpak?

Wat zijn de belangrijkste uitgangspunten in het vormgeven van het schoolprogramma?

Welke andere partijen (m.n. schoolleiding) hebben een rol in de vormgeving van het U-TA schoolprogramma?

**Organisatie**

Hoe wordt de stuurgroep materieel/ professioneel/ organisatorisch ondersteund bij het vormgeven van het schoolprogramma?

**Samenhang met andere ontwikkelingen**

Hoe hangen de huidige ontwikkelingen samen met andere (huidige of toekomstige, beoogde) ontwikkelingen binnen de school?

**Schoolprojecten / Voor- en nabereidingsactiviteiten / Differentiatie / Community-vorming:** *The boxed questions are asked separately for each of the four aspects of the school programme for U-Talent Academy*

**Welke beslissingen** zijn sinds het vorige interview genomen op dit onderdeel van het schoolprogramma voor U-Talent? (op inhoudelijk/ organisatorisch/ didactisch gebied?)

**Wat is de volgende stap** die jullie willen zetten in het vormgeven van de schoolprojecten?

**Vraag betreffende aanpak en de stuurgroep:** *Asked in second and third interview*

Welke verwachtingen t.a.v. het schoolprogramma van U-TA zijn inmiddels bijgesteld en waarom?

Welke geplande activiteiten t.a.v. de vormgeving van het schoolprogramma zijn inmiddels bijgesteld en waarom?

Wat en hoe wordt er over en weer gecommuniceerd over de ontwikkeling van het schoolprogramma?

Wat levert deze manier van samenwerking/ communicatie op?

**Terugblikken op afgelopen periode:** *Only in the exit-interview*

Waar moest (of moet nog) het meeste aan veranderen, voor de implementatie van het U-TA schoolprogramma…

…op didactisch vlak?

…op inhoudelijk vlak?

…op organisatorisch vlak?

Wat zijn volgens jou de belangrijkste kenmerken van jullie U-TA schoolprogramma?

…Wat biedt dit voor nieuwe mogelijkheden voor jullie leerlingen?

…Wat wordt de meerwaarde van jullie schoolprogramma?

Wat hoop/verwacht je dat het schoolprogramma voor de leerlingen zal opleveren…

…die deelnemen aan U-TA?

…die deelnemen aan alleen het schoolprogramma?

…die niet deelnemen aan het schoolprogramma?

# Appendix B

Coding scheme for decisions about curriculum components

| Curriculum component | Answers the question: | Examples of quotes |
|---|---|---|
| Rationale | Why are they learning? | It is intended to have all these activities fit within a framework, in which it is important to emphasize the development of talents, talent for science and mathematics. |
| Aims & objectives | Towards which goals are they learning?<br>*Including knowledge-, skills-, and attitude goals* | The goal is for students to acquire academic skills. |
| Content | What are they learning?<br>*Including how the content is being characterized (e.g. 'interdisciplinary', 'advanced', 'regular', etc.)* | The school projects in the project-classes, those will be interdisciplinary of character. |
| Learning activities | How are they learning?<br>*Including how assignments are being characterized (e.g. 'open-ended'); how the way of working is being characterized (e.g. 'independency'); and activities related to community building.*<br><br>*Excluding statements about obvious activities in the U-TA school programme, like 'they are doing their projects'* | Students will get a lot of independence, and they are required to sort out a lot of things [referring to tasks] by themselves. |
| Teacher role | How is the teacher facilitating their learning?<br>*Including what kind of interactions will take place between teachers and students;* | I will evaluate the students' schedule together with them. |

| | | |
|---|---|---|
| | *and what kind of attitude the teachers have towards their students (see example)* | |
| Materials and resources | With what are they learning? *Including the source of learning materials (see example)* | We have lesson materials from NLT; these we will use. |
| Grouping | With whom are they learning? *Including the number of students and the 'type' of students involved; and the students' roles with respect to one another (e.g. collaborative or competitive)* | They will always be working on a school project in groups of 2-3 persons. |
| Location | Where are they learning? *Including statements about during which classes activities will take place (e.g. during science class): in which case it is also about* **Time***.* | Students will be working on their projects during talent-classes, which are especially scheduled for students in the talent programme. |
| Time | When are they learning? *Including the time spend on activities; where in the weekly schedule certain activities are being planned (e.g. 'during regular classes': in which case it is also about* **Location***)* | Students will work on their project during a couple of weeks, and they will use 2-3 lessons per week to work on that. |
| Assessment | How is their learning assessed? *Including <u>what</u> is being assessed (e.g. end-products of science projects) and how; and how students' capability to participate in the U-TA school programme will be assessed.* | I will assess students' presentations on containing enough in-depth information on the topic, for instance. |
| Extra code: process of decision- | Explaining on decisions about the process of development itself, which explains something | It is not yet relevant to discuss matters of content for the school projects, as long as we do not have clarity on the |

| | | |
|---|---|---|
| making on curriculum components | about the sequence/lack of decisions about certain curriculum components | organizational framework. |

# Appendix C

Codebook on quality considerations / motivations for curriculum components

*Coding Scheme for the Arguments Given by Teachers for Curriculum Decisions*; Quality markers (i.e. categories) are based on Nieveen (1997; 1999).

| **Category** | **Category explanation** | **Code – kind of argument** | **Example** |
|---|---|---|---|
| (expected) Effectiveness | It is expected that students appreciate the learning program and that desired learning takes place. | Based on beliefs about effectiveness (including references made to experiences from classroom practice; either from their own or from colleagues) | Students who got an alternative assignment, delivered good work. |
| | | | Ditto |
| | | | Students who will get the freedom to do their work elsewhere, will feel privileged and work really hard. |
| (expected) Practicality | The decision meets the needs, wishes, and contextual constraints of the teachers and students; teachers consider it usable; it is easy to use materials in a way that is largely compatible with the developer's intentions. | Based on beliefs about practicality. | Time is needed for teaching the regular curriculum.<br><br>Or:<br>This allows students to work independently on their assignments. |
| Availability of resources | This is what is available; due to limited options. | Based on the resources available | Grouping students from multiple grades together because there are no more teachers available for a science project-class. |
| Relevance | Decisions are based on state-of-the art knowledge. | Based on external sources (e.g. JCU) | This decision fits with the manner in which students work at JCU. |

| | | | |
|---|---|---|---|
| | | Based on other beliefs about relevance | I think it is important that students know something about the history of natural sciences. |
| Consistency | Decisions are consistently linked to one another. | In response to other decisions/ideas regarding another curriculum component | Grouping students from multiple grades means that they have to work independent from the teacher on their projects. |
| | | Based on preconditions from another (overarching) school programme | [other programme] demands that at least part of the (regular) subject matter is being learned within school projects. |
| Motivation unclear | The teacher explicitly tells that there is no clear motivation or that someone else should know, since they were not the ones who made the decision. | Decided on / demanded by someone else (e.g. school leaders) | M. thought that we should start with this module, so that is what we'll do. |
| | | Not given any thought by the teachers (interview) | In response to the question: "Why did you choose to make the school projects interdisciplinary?" "Funny, I don't know, we just all thought it was really important." |