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**Author:** Dam, Michiel

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# Chapter 6

## GENERAL CONCLUSION AND DISCUSSION

### 6.1 Aim and research questions

Research on the implementation of educational reforms has shown that successful implementation ultimately relies on teachers and how they work out the reform proposal in their classrooms (Borko, Jacobs, & Koellner, 2010; Fullan, 2007; Van Driel, Beijaard, & Verloop, 2001). Therefore, teachers should be given opportunities to learn how to work out a reform proposal in their everyday classroom practices. Such teacher learning is mostly facilitated through professional development (PD) initiatives. The biggest challenge is to design PD opportunities for teachers that can lead to fundamental changes in their teaching practices (Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2010). However, teachers' everyday classroom settings and programs of action can hold several limitations and challenges for teachers who wish to implement change (Doyle, 2006; Doyle & Rosemartin, 2012). For a successful implementation of change proposals into classroom practices, teachers should consider the change proposal to be practical (Janssen, Westbroek, Doyle, & Van Driel, 2013b). Practicality (Doyle & Ponder, 1977) refers to teachers' perceptions of the potential consequences of attempting to implement a change proposal in the classroom. The practicality of most educational reforms is considered to be rather low, as they are mostly formulated as visions or ideals and not as programs for classroom practice (Borko, 2004).

The aim of this research project was to make a context-based reform proposal in biology education practical for teachers and study the development of teachers' instructional approaches and intentions to change. Making an educational reform practical requires a focus on the three criteria for practicality first described by Doyle and Ponder (1977): Instrumentality focuses on the extent to which the proposal contains instrumental content such as procedures or methodologies which help teachers to envision how the change proposal would work out in their classrooms; congruency refers to the extent to which a proposed change is congruent with teachers' perceptions

of their own situations; cost refers to the ratio between the investment in terms of time and effort and the return in terms of benefits in classroom practices or student learning. In this research project, the overall research question was:

*How can the context-based approach to biology education be made practical for teachers?*

Four studies were performed to answer this question. In these studies, the context-based educational reform was made practical using two approaches: First, a modular approach offered teachers the possibility of accomplishing the context-based approach to education by combining and adjusting lesson segments that they were familiar with in their regular instructional approach. Second, a success-oriented approach focused on teachers' possible earlier successful experiences with (parts of) the context-based approach. They could use such earlier successful experiences to propose changes to their regular instructional approach and bring it in line with the approach of the context-based educational reform. In this research, these two approaches were used in: (1) The design of a PD program aimed at assisting teachers in making changes to their instructional approaches in line with the requirements of the proposed reform (Chapters 4 and 5); and (2) The design of an interview technique (MECI) aimed at assisting teachers in formulating strong intentions for change (Chapter 3). Before conducting these studies, however, we first had to construct and validate a tool for the modular approach (Chapter 2).

## **6.2 Summary of conclusions per study**

In the **first study** (Chapter 2), we focused on the construction and validation of a modular ID model to assist teachers in making changes to their regular practices and expanding their repertoire of instructional approaches. In the construction phase, we proposed that a practical approach to ID should be based on the concept of modularity (Baldwin & Clark, 2000; Campagnolo & Camuffo, 2010; Holland, 2000). A modular approach in educational settings refers to the possibility for designers to use a set of lesson segments. In this way, they can build upon that which is already present and construct several different designs using the same set of lesson segments. Following the initial model construction and a pilot, eleven experts on: a. teaching in secondary schools; b. teachers' lesson design; and c. the use of models to design lessons, gave their opinions and recommendations regarding the strong and weak points of the

initial ID model through a three-round Delphi study. In the study, the most important adjustments were made to the content of the lesson segments, the ways that teachers can design the regulation of each lesson segment (done by either the teacher, or students, or shared), and the addition of metacognitive elements to the model. The experts in the Delphi study reached consensus on a modular ID model that complied with the following criteria of internal validation: Comprehensiveness, expected practicality, and expected effectiveness.

The resulting ID model relates to the criteria for practicality (Doyle & Ponder, 1977) in the following way: (a) The resulting lesson segments and their regulation can easily be understood at classroom level (instrumental); (b) Teachers do not have to discard their existing approaches, but can take their most common instructional approach as a starting point for change (congruent); and (c) Teachers do not have to attend faraway meetings or get much training to use this model, but can use it immediately in their own setting and time (low cost).

In the **second study** (Chapter 3), we focused on teachers' intentions to implement the context-based biology reform proposal. Professional development aimed at the implementation of an educational change proposal often focuses on the skills and knowledge that have to be improved and/or on changing the environment in which teachers work. However, there is another very important condition for successful change: the formulation of strong intentions to change (Fishbein & Ajzen, 2010). Often, formulating strong intentions to change is not included in professional development programs. In this study, we studied the impact of a so-called 'motivating-for-educational-change' interview (MECI) technique on the intentions of nine biology teachers to implement the context-based reform proposal. We explored the teachers' intentions to change, and compared both the strength (scored on a 1-7 Likert scale) and the specificity of the intentions after using the MECI technique with a baseline test ( $t=0$ ). The MECI technique comprised both the modular and the success-oriented approach; the teachers explicitly built upon earlier successful teaching experiences with context-based education and used modular lessons segments to propose changes to their regular approaches to instruction.

We concluded that the strength of the teachers' intentions to change was promoted by the MECI technique. Also, eight out of nine teachers formulated more intentions after the MECI than in the baseline test. The results further show that their intentions after using the MECI technique were more specific, as shown in their descriptions of how they planned to carry out the reform. This in turn may have had a positive influence on the strength of the intentions: Gollwitzer (1999) found that the more specific an intention is about the how, when and where, the more easily a certain goal behavior is attained.

What became apparent from the results of the MECI is that the technique manages to combine earlier successful experiences and the set of lesson segments in order to motivate teachers for change. All teachers were able to think back to relevant successful experiences using (parts of) the context-based approach, which had a positive influence on the strength of their intentions. For example, one participant (Ivy) mentioned that she had once made pupils work in small groups focused on personal stories from cancer patients. This had motivated her students to work hard during that lesson. As a result of envisioning how a particular form of context had worked out in her classroom in the past, she formulated a strong intention to use a context again in the future. Also, teachers mentioned that the rearrangement of lesson segments helped them to feel able to carry out the reform. Through comparing their regular approach to instruction with that of the context-based reform proposal, teachers were able to see that they sometimes already carried out the reform in a small, adapted way. Walter (participant): "So if the reform program proposes a context to engage and motivate students to find information themselves, this means that I sometimes already apply part of the reform within my regular lessons?" The findings of this study show that making the context-based reform practical by using lesson segments (modular approach) and focusing on earlier successful experiences (success-oriented approach) can result in the formulation of strong and specific intentions for change. The MECI technique could be a useful tool to administer at moments such as the start of a professional development program, or when motivation is lacking to continue professionalization.

In the **third study** (Chapter 4), we designed and tested a PD program that was aimed at making the context-based educational reform practical. We designed this

PD program on the basis of the following three design principles: (1) Allow teachers to build on earlier successful experiences (success-oriented approach); (2) Allow teachers to accomplish the innovation by recombining and adjusting existing lesson segments (modular approach); (3) Support teachers from a distance and according to their individual needs. In the PD program, eight biology teachers were supported in changing their instructional practices towards the context-based reform proposal. The participating teachers each designed, taught, and reflected on four lessons for their own teaching practice. We studied the development of their instructional practices and also the strength of their intentions for each of the lessons designed in the PD program. We concluded that the participating teachers showed that they had strong intentions to start their development and that these intentions remained strong throughout the entire PD program. We also concluded that the participating teachers each had their individual processes of change, in which they developed their teaching repertoire towards the context-based innovation in a fairly independent manner. However, there proved to be a number of sequential steps for most teachers in changing their instructional approach towards the context-based educational innovation (see section 4.4.2).

The outcomes of this PD program showed that each element of the PD design had its own role. The success-oriented approach appears to have had an effect on the strength of intentions. Thinking back to successful experiences and working with one's strengths appears to foster strong intentions for the next lesson. In this, the success-oriented approach also helps teachers to connect the proposed reform to their regular practices and, hence, relates specifically to the congruence criterion of practicality (Doyle & Ponder, 1977). The modular approach was described by teachers as highly practical. In the final interviews, the lesson segments were considered to be an important instrument in designing lessons and in understanding the methodological implications of the innovation. The participants were able to diminish the gap between the reform proposal and their regular teaching practice by recombining and adjusting their existing sequence of lesson segments. In this way, the modular approach relates to both congruency and instrumentality. The final principle underlying this study was the support of teachers from a distance and according to their individual needs. The majority of participants appeared to regard this as very pleasant and not as time-

consuming as group meetings. This final principle relates specifically to the cost criterion of practicality.

The **fourth study** (Chapter 5) was explicitly focused on ways in which teachers can use their students' data to evaluate their lessons, find successful experiences, and build on these earlier successful experiences to change their instructional approaches. In this study, participating teachers (n=5) used multiple Plan-Do-Check-Act (PDCA) cycles in which they collected, interpreted, and used students' data to make changes to their instructional practices. First, participants were asked to design a lesson in which they made a change towards context-based education (Plan). The second step was to teach that lesson and gather data on students' learning outcomes and regulation of student learning processes in the lesson (Do). The third step was to interpret these data (Check) and use them to propose new changes to their instructional practices (Act), which served as input for the next lesson design (Plan), etc. During the process of interpreting and using students' data, we supported participants using practical frames (Klein, Moon, & Hofman, 2006) that were designed to enable them to better understand students' data and make productive changes. These frames were the following: (1) Lessons can be seen as specific sequences of lesson segments; (2) Regulation of the learning process can be done by either the teacher, or students, or shared; and (3) There are different types of contexts and these can have different functions. We examined how the practical frames contributed to teachers' interpretation and productive use of students' data. We also studied how the use of students' data influenced participating teachers' development. The results showed that participants were able to use the frames that we provided to interpret students' data and make productive changes to their instructional approach. In this way, they were able to overcome the common problems of not knowing how to interpret data and productively use students' data for implementing change (Ingram, Louis, & Schroeder, 2004; Mandinach, 2012). Using students' data also influenced the development of the participants in several ways. For example, when students' data showed that a lesson was successful, participants used one or more frames to explain why it was successful. Participants also tended to maintain that successful change in their following lesson design, followed by another change proposal using the same frame or a different frame. In this way, participants used students' data to change their

instruction one step at the time. They started with their regular instructional approach as starting point and gradually changed their instructional approach towards that of the context-based reform.

### **6.3 General discussion**

In the current research, a context-based reform was made practical using two approaches: a modular and a success-oriented approach. The results and conclusions from the various studies revealed that this supported teachers in (1) formulating strong and specific intentions for change in the direction of the reform and (2) changing their classroom practices in a stepwise manner towards the aims of the context-based reform proposal. The question remains how these two approaches functioned in making the context-based approach practical.

The modular approach seems to have made several contributions in making the reform practical, with reference to the specific criteria of practicality theory. First, it made the reform proposal easy to understand at classroom level, which specifically relates to the instrumentality criterion. Participating teachers were able to represent both the reform proposal and their regular instructional approach using the same set of lesson segments, which helped them to understand the methodological implications of the reform. Some participants mentioned that the modular lesson segments could be used by teachers in other settings to discuss and compare their approaches to instruction. As such, it may serve as a common language or shared terminology for teaching, which was found to be lacking in the area of teacher learning (Grossman & McDonald, 2008). Second, the modular approach made it possible to take one's regular instructional approach as starting point for change and make stepwise changes, which refers to the congruency criterion of practicality theory.

Having a success-oriented approach also seems to have made specific contributions to practicality. First, it enabled relating the proposed reform to what teachers already successfully accomplished in their classroom. As such, it specifically relates to congruency. Second, thinking back to successful experiences in concrete settings where the behavior was previously enacted made intentions more specific and also gave directions for change. This increases instrumentality. Third, when participants



identified successful experiences in previous lessons by, e.g., looking at their students' data, they maintained the successful change in their subsequent lessons. This shows that building on successful experiences also contributes to the stepwise manner of change, which was further facilitated by the above-mentioned lesson segments. This aspect of the success-oriented approach also relates to congruency.

The two approaches combined gave participating teachers the possibility to compare the proposed reform with their regular instructional approach at classroom level, to propose strong intentions for change on the basis of earlier successful experiences, and to make stepwise changes to their instruction in the direction of the proposed reform. The teachers were able to work in their own classroom settings, using the available resources and time. Because the teachers were able to see the benefits for their classrooms, and the costs in terms of time and effort were low, this aspect relates specifically to the low cost criterion of practicality theory.

Coming back to the literature on the implementation of educational reforms and the important role of PD, it is relevant to discuss the list of known features of high-quality PD (Borko et al., 2010; Garet, Porter, Desimone, Birman, & Yoon, 2001; Supovitz & Turner, 2001; Van Veen, Zwart, Meirink, & Verloop, 2010). Such features provide only a rough sketch of teachers' effective learning and they do not seem to take practicality into account. Practicality theory imposes certain requirements for the effective implementation of a change proposal; nevertheless, it does not specify how to implement a reform successfully. To do this, the practicality requirements need to be elaborated in specific approaches and learner programs that relate to these requirements and the above mentioned features of high-quality PD. The findings of the studies in this dissertation appear to give directions for such an elaboration of some of these features.

1. *PD content is situated in practice and addresses problems of practice.* The current findings have shown that it is not only important to design, teach, and reflect on concrete lessons (situated in practice), but that this should be done in a practical, success-oriented way. Most teacher learning uses a deficiency approach, in which teachers are expected to remedy their shortcomings, but the success-oriented approach used in this research has an opposite focus. By using earlier successful experiences, made visible using

lesson segments, attention is given to particular strengths of individual teachers and intentions to change that they already have or have yet to develop. The lesson segments used in this research can also be helpful for making stepwise changes towards a change proposal, with teachers' regular practice as starting point.

2. *The content of PD is focused on students' learning.* This is often elaborated by focusing on those aspects of teacher learning that immediately influence student learning, but this can be difficult due to the complex setting of the classroom which allows little time for such efforts and makes it hard to know which aspects of lessons influence students' learning. A following step is the productive use of students' data for implementing change, in which students' data, for example, learning outcomes, are used to propose changes to practices: data-based decision making. A major problem in data-based decision making, however, is that teachers have difficulties with both the interpretation and the productive use of students' data. The current research showed that both the process of collecting students' data and the process of interpreting and using students' data can be facilitated by combining a modular and a success-oriented approach. When teachers collect students' data from a lesson they gave, the lesson segments can help them to interpret why the outcomes were higher or lower than expected and propose change. Taking a success-oriented approach helps teachers in a cyclic process of reflection, and especially helps them to formulate strong intentions to improve their students' learning even further.

3. *Teachers learn actively.* The outcomes of the present research indicate that teachers indeed have to learn actively, but that this should connect with their own tasks and challenges in order to obtain low costs in terms of time and effort.

4. *The PD setting is school based.* Situating teacher learning in schools can be done in several ways. The current research findings emphasize that teachers do not always have to attend workshops or meetings, but can also be supported from a distance and on demand whilst working in their own school environment. For this, they can use both a success-oriented internet environment that facilitates progression and motivation and a set of lesson segments that helps them to design lessons for their own practice, and make stepwise changes.

5. *Teachers preferably learn collaboratively and in professional learning communities.* In the present research, it became clear that teachers can also be individually supported in

changing their classroom practices. For a further elaboration, see section 6.5.

The findings of the present research have illustrated that reforms can be made practical by using two approaches: a modular approach and a success-oriented approach. These findings may provide a new perspective on how to successfully implement educational reforms. In describing the gap between the design and the enactment of educational reforms, Doyle and Rosemartin (2012) present two distinct perspectives on the implementation of reforms: the reformers' perspective and the teachers' perspective. The reformers' perspective mostly emphasizes the use of innovative materials and implies that PD should increase teachers' capacity to use those materials. The teachers' perspective emphasizes teachers' professional expertise and autonomy, which may lead to creative adaptation of a reform with the risk of losing the essence. Much of the research on the implementation of reforms is done from the reformers' perspective. Such research focuses on how teachers can best be trained to use materials associated with the reform according to their design, and often sees teachers as obstacles to successful implementation (Davis & Krajcik, 2005; Remillard, 2008). Neither of these two perspectives, however, will succeed in achieving the ultimate goal of educational reform: changed classroom practices in line with the essence and goals of the reform proposal. In the present research, a new perspective was introduced which is not so much grounded in the teachers' or the reformers' perspective. Instead, it emphasizes both the teachers' complex classroom setting with its practical requirements, and has a strong focus on the essence and goals of the proposed reform, while aiming for changes in instructional approaches.

## **6.4 Limitations and recommendations**

In the first study (Chapter 2), the ID model was found to be internally valid by the experts who participated. A possible future research question is the following: How can an ID model that supports teachers in continually expanding their repertoire of instructional strategies be externally validated? There are also limitations to the qualitative research that was performed; therefore, it is recommended that future researchers use larger numbers of participants. As regards the second study (Chapter 3), it is recommended that the MECI be tested in other settings, for other reforms,

and for other school subjects. A future research question following from the second study would be: What are the developments in teachers' beliefs about a context-based reform when using a MECI interview? A future research question related to the third study would be: What are the important characteristics of an internet environment that supports teachers in independently changing their instructional approach towards that of a change proposal? From the fourth study: How can teachers collect students' data in an independent way? One of the other challenges of this research was to apply the modular and success-oriented approaches to the implementation as currently carried out. Therefore, we propose the following future research questions: What are the developments in teachers' intentions to implement the context-based educational reform in secondary biology education? And what are the impacts on the development of teachers' intentions and teaching practices of making the context-based educational reform practical? Another future research question relates to the development of beliefs during a PD program: How will teachers' beliefs about specific intentions develop in the span of a PD program for learning to design context-based education? It would also be interesting to study the role of traditional and reformed textbooks or sample materials in the implementation processes, as these can have specific promoting or hindering impacts on teachers' learning processes. It is also recommended that future research takes the process of recontextualization (Van Oers, 1998) into account, as this was not included in this study.

## **6.5 Implications**

The first implication of this research concerns how educational reforms can be implemented successfully. A reform proposal should first be elaborated into a modular representation of the content. The smaller segments of the proposal should be formulated in terms of what teachers already do or know, and at classroom level. Following this, it is important to identify teachers' personal strengths and earlier successful experiences, for example, through a 'motivating-for-educational-change' interview (MECI). In this interview, teachers can formulate personal intentions to make changes to their regular instructional approach. This interview should be followed by offering teachers a PD program which can be carried out either by individual teachers

or by groups of collaborating teachers. In such a PD program, teachers should (1) build on earlier successes using (parts of) the proposed reform to maintain strong and specific intentions for change and (2) use a modular approach to make stepwise changes to their regular instructional approach. Furthermore, such a PD program should be school based and structured around teachers' own classroom settings and the available time and resources.

A second implication concerns the form of collaboration in PD initiatives. It is emphasized in literature that learning is most effective when teachers collaborate and form groups of learners (Borko et al., 2010). In this research, however, we have shown that teachers are also able to change their practices relatively independently, if supported with an internet-based reflection tool. Through this internet tool, teachers were supported from a distance and according to their individual needs. Such an approach can support the implementation of educational reforms particularly by giving learning opportunities to teachers who have no time, possibilities, or desire for collaboration. Furthermore, such an approach is less time-consuming than group meetings, because it allows teachers to decide when they wish to design lessons or reflect on their lessons.

A final implication concerns the role of teacher education in preparing teachers for the teaching profession. As teaching is never routine, and specific settings require specific lesson designs, teachers should be able to design a large number of instructional approaches, and not just a few. The modular approach used in this research states that lessons can be seen as specific sequences of lesson segments and that regulation of the learning process can be done by either the teacher, or students, or shared. As such, it can be seen as a tool to design many forms of instructional approaches. Teacher educators can teach pre-service teachers how to use this tool to design a large variety of instructional approaches for specific purposes, while taking the often complex and demanding context of the teaching profession into account.