

# Networking the documentational approach and Valsiner's zone theory

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*The documentational approach to didactics (DAD) and Valsiner's zone theory are combined to increase explanatory power when exploring pre-service teachers' professional development. The strategy of combining is applied, forging a model that serves to theorise and support a resource approach to mathematics teacher education. DAD delineates the relationship between pre-service mathematics teachers and resources through the concept of documentational genesis. The context and its influence on the documentational genesis is rendered in terms of the zone of free movement and the zone of promoted action. Thus, the theoretical framework presented provides a tool to discern and a language to discuss pre-service teachers' professional development in interaction with resources for teaching mathematics. The case of Oda provides an example that illustrates how tension in her zone system influences her interaction with resources and her professional development.*

*Keywords: Documentational approach to didactics, zone theory, networking, theoretical framework.*

## Introduction

The purpose of this paper is to explore how the documentational approach to didactics (DAD) (Gueudet & Trouche, 2008) and Valsiner's zone theory (Valsiner, 1997) can form a networked understanding of the empirical phenomenon of pre-service mathematics teachers (PSTs) creating a resource bank for teaching mathematics. In accordance with the networking strategies introduced by Prediger et al. (2008), the two theoretical approaches are combined setting out from *documentational genesis* presented by Gueudet and Trouche (2009, p. 209). The two approaches will be elaborated below; however, I begin by setting out my rationale for taking a resource approach to mathematics teacher education.

The proliferation of teaching resources on the internet during the past two decades, has spurred researchers' interest in the relationship between teachers and the resources they use (Pepin et al., 2017; Remillard, 2005). Gueudet et al. (2019) state the following:

It seems more and more frequent to consider that the interactions between the teachers, following teacher education courses, and the resources they use are important and that they can enlighten evolutions in teachers' knowledge and practices. (Gueudet et al., 2019, p. 4)

The divide between experts as designers and teachers as users is decreasingly discernible, as practicing teachers are increasingly responsible for designing, selecting, and implementing resources (Gueudet et al., 2016; Gueudet et al., 2012). In the interest of educating mathematics teachers who are prepared for the diversity of tasks they face in their professional lives, a resource approach to mathematics teacher education holds promise. Having PSTs select resources, transform resources, implement them, and revise them as part of their coursework can provide learning opportunities grounded in practice (Sødal, 2022).

As the rationale for networking DAD and zone theory is based on an empirical phenomenon, I will be referring to the study in question throughout the paper. The inquiry investigates how (if at all)

working hands-on with resources for teaching mathematics, in the context of university coursework and school placement, facilitates professional development for teaching mathematics. Moreover, it explores PST's agency in professional development. However, the focus in this paper is on how the networking of DAD and zone theory supports such an approach, and not the empirical results.

A central tenet within DAD is that teachers learn from *documentation work* and that interacting with resources is a central part of their professional development (Gueudet & Trouche, 2012). However, what promotes this development can be opaque and challenging to operationalize in terms of DAD. To address this, Valsiner's zone theory is combined with DAD. Specifically, I illustrate how the zone of free movement/zone of promoted action complex can be connected to the process of documentational genesis to gain explanatory power for how the context influences the process. I begin with presenting DAD and Valsiner's zone theory, then combine (defined below) the two in a theoretical framework. Finally, the applicability of the combined framework is illustrated through an empirical example.

### **The documentational approach to didactics**

The scope of the documentational approach to didactics (DAD) is to study "the interactions between teachers and resources and their consequences, in a context where an abundance of teaching resources is available, on the Internet in particular." (Gueudet, 2017, p. 200). Following Adler's (2000) definition of a resource, DAD takes a broad perspective on resources as anything likely to *re-source* the teacher's practice, also incorporating peers/colleagues (Trouche et al., 2020). While Rabardel's instrumental approach proposes a distinction between an artefact and an instrument, DAD distinguishes between a *resource* and a *document*. A *document* is created when a *resource* is combined with a *scheme of utilisation* (a regular way of acting for a particular goal), through a process called *documentational genesis*. This is an ongoing process of geneses where resources and documents can be combined, forging new documents that are part of the teacher's *resource system*. It is important to observe that a document in this context diverges from the every-day term. The specific term of document used in DAD is derived from research on l'ingénierie documentaire (in French) where a document as a product is connected to its usages (Gueudet & Trouche, 2008; Pédaque, 2006). Within DAD, a document is inextricably linked to the process of combining resources and schemes of utilisation. The teacher interacts with a resource through a dual process of instrumentation and instrumentalisation. Through instrumentation, the resource influences and shapes the schemes developed by the teacher. Through instrumentalisation, the teacher modifies the resource according to his/her existing schemes (Gueudet, 2019).

Vergnaud (1998) defines a scheme as an invariant organisation of activity to achieve a certain goal. Albeit being described as invariant, the authors claim schemes can evolve through documentation work (Gueudet & Trouche, 2012, p. 26). In this resides a central tenet of DAD; that teachers learn through documentation work. Vergnaud (1998, p. 230) define schemes as "the operational side of knowledge". It is knowledge in action (in French: *connaissance*). What needs to be observed by the researcher then, is the teacher's regular ways of acting for a class of situations (e.g., teaching fractions). In this study, what is investigated is the development of PSTs' schemes for creating a resource bank for teaching mathematics, and the evolution of these schemes in the context of

university coursework and in school placement. However, operationalizing how a change of scheme is instigated by the help of DAD alone proved challenging. To mitigate this, the connection to and influence of the context is rendered in terms of Valsiner's zone theory and productive tensions (explicated below).

### **Valsiner's zone of free movement and zone of promoted action**

Goos (2013) suggests an adaptation of Valsiner's zone theory, and presents how the framework can be used to study teacher learning and development. Valsiner's zone theory is an evolution of Vygotsky's zone of proximal development (ZPD) that considers the social setting and the goals and actions of human participants (Goos & Bennison, 2019). Vygotsky's ZPD represents the distance between what a child is able to do on his/her own and what s/he can do with the help of a more knowledgeable other (the child's environment can also act as "the knowledgeable other") (Goos, 2013). Similarly, Valsiner (1997, p. 200) defines the ZPD as "the set of possible next states of the developing system's relationship with the environment...". It constitutes the aspects of development that are currently in the process of becoming actualised. However, Valsiner's ZPD is a narrowed-down rendition of Vygotsky's concept that is subservient to the two zones introduced by Valsiner: the zone of free movement (ZFM) and the zone of promoted action (ZPA).

The ZFM structures the learner's access to different areas in the environment, the availability of different objects within an accessible area and the learner's ways of acting with the available objects (resources) in the accessible area (Valsiner, 1997, p. 188). A ZFM is formed in interaction with cultural meaning systems and regulate an individual's relationship with the environment (e.g.: criteria for creating the resource bank). Furthermore, in effect of development taking place, the student learns to set up a ZFM in his/her personal thinking and feeling. Thus, the ZFM becomes internalized (ibid.).

A person's actions are promoted through the ZPA, which is comprised of a set of activities, objects, and areas in the environment. For a PST, the ZPA could represent reflection on their practice, promoted through teacher education courses or experiences in school placement. It could also include interaction with their peers, or tutors involved in their education. A tutor might attempt to promote a student's actions e.g., through a resource they consider essential for the student's development. The student may, but does not have to, engage in the interaction with that object. Moreover, the student could decide to engage with other objects within the ZFM rather than the one offered by the tutor. A ZPA then, is of a nonbinding nature. The student cannot be made to act within the ZPA, unless the ZPA is turned into a ZFM. Together, the ZFM and the ZPA form a complex that directs development along a set of possible pathways (Goos & Bennison, 2019; Valsiner, 1997). As development takes place, the ZFM/ZPA complex frames the process of internalization. Subservient to this complex, the student's ZPD is constructed (in negotiation with the environment), guided by what is permitted (ZFM) and promoted (ZPA) at the time (Valsiner, 1997, p. 200).

Valsiner (1997) uses the term *constraint* to delineate the areas of the zones. He specifies that he uses the term free of the negative connotation from common language; it simply serves to delimit the "bounded indeterminacy" of the zones at any given moment in the developmental trajectory. A *bounded indeterminacy* connotes that the boundaries of the zones are fuzzy or semipermeable (sometimes even undefined); the zones are only quasi-defined and subject to further transformation.

In this flexibility of the concepts lies their capacity for capturing the indeterminate nature of the phenomena. Consequently, development is constrained rather than determined. Capturing this ephemeral nature of development is the aim of zone theory analysis (Goos, 2013; Valsiner, 1997). Goos (2013) maintains that the notion of *productive tensions* is pivotal for understanding teacher change from a zone theory perspective. Tensions can be thought of as misalignments within the zone system. If a PST's ZPD does not map onto the ZFM/ZPA complex, the desired development will not take place. This fosters dissatisfactions and further, tensions. If the tension triggers change that seeks to bring the zones back into alignment, it is considered a productive tension.

### Combining DAD and zone theory

The rationale for networking DAD and zone theory, is to increase in explanatory power for the empirical phenomenon in question. Accordingly, following the landscape of strategies for connecting theoretical approaches presented by Prediger and Bikner-Ahsbabs (2014), I align with the strategy of coordinating/combining. Prediger et al. (2008) emphasise the need to carefully analyse the elements of the theories' respective cores to decide on the appropriate degree of integration between theories. I elucidate below how DAD and zone theory have adequate compatibility for combining them, creating a theoretical framework for studying the evolution of PST's resource banks for teaching mathematics while participating in university practice and school practice (unit of analysis).

Both DAD and Goos' (2013) extension of zone theory study teacher learning in terms of change through interaction with the environment. In DAD, (pre-service) teachers learn through an ongoing process of documentational geneses, resulting in socially created documents as part of their practice. Teachers shape and modify the resources according to their schemes, and the resources influence and shape the teachers' schemes and thus, their practice. Furthermore, the process of documentational geneses happens in two intersecting practices. PSTs are part of a practice in university, and they are part of a practice in school placement. In these practices they interact with the environment, the people in it, and the resources they offer. This interaction renders a set of possibilities for development of new knowledge, schemes, goals and practices, thus forming the PST's ZPD. The ZFM structures the PST's environment, and the ZPA encompass actions promoted by the teacher education programme and interaction with peers/mentor teachers that promote certain teaching approaches (adapted from Goos, 2013). The ZFM/ZPA complex serves to explicate the relationship between the documentational genesis and the context. A representation of this relationship is presented in Figure 1, which is an adaptation of the original model of documentational genesis in DAD:

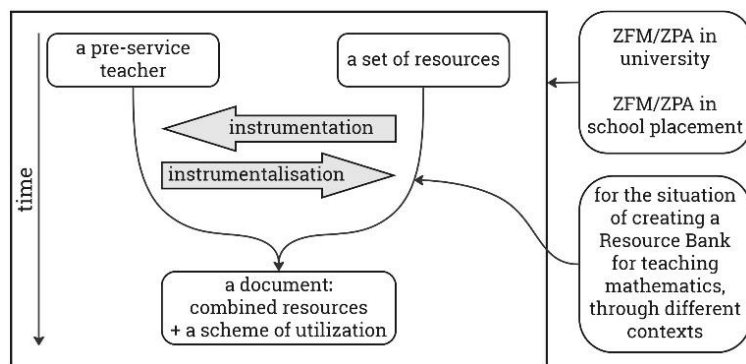


Figure 1: Model of the theoretical framework, adapted from Gueudet and Trouche (2009, p. 206)

The contribution of this adapted model is that the context is specified through the ZFM/ZPA complex and thus, it delineates how the context could influence the inner process. Change happening within the system is operationalized through the notion of productive tensions (as described in the previous section). Accordingly, the model provides a framework for analysing both the relationship between (pre-service) teachers and resources, and in what ways the context shapes this relationship.

Like Valsiner, I consider development/change to be constrained rather than determined. A salient contribution of both zone theory and DAD is the emphasis on individual agency. Notwithstanding the prominence of interdependence between the student and the environment in Valsiner's theory, he also states that students (Valsiner refers to children) learn to change their environment when pursuing their Objectives<sup>1</sup>. Hence, the students participate in their own further development; they are agents in their own learning (Breive et al., 2022; Valsiner, 1997). Likewise, in DAD, teachers are professed to have an active role in their interaction with resources. They interact with (cultural) resources, modify and enact these resources as part of their professional activity. In turn, they learn and develop professionally, which connotes that they are agents in their own learning (Choppin, 2019). Correspondingly, the framework makes it feasible to study the role of agency in professional development. DAD provides this perspective in relation to the resource bank. Concurrently, the ZFM/ZPA complex provides this perspective in relation to the different contexts of the PSTs practice and how this can influence the evolution of the resource banks.

Admittedly, DAD has a constructivist heritage (e.g., Vergnaud's schemes and their relation to Piaget's schemes), whereas zone theory has a socio-cultural heritage. Further, while the interdependence between the learner and the environment takes centre stage in zone theory, it is somewhat more peripheral in DAD. Nevertheless, the two approaches unify considering development. Vergnaud (1998) elucidate schemes as knowledge in action. Following DAD, a teacher's schemes can develop and therefore, so too can their actions through practice. Valsiner refers to development as the emergence of new domains of action (and thinking) (Goos, 2013). Hence, in both approaches, development takes place as teachers take part in a practice, interacting with the environment, the people in it, and a variety of (cultural) resources therein. Therefore, I argue the two theories to be compatible. In the next section, I present an empirical case that serves to exemplify how the framework supports a resource approach to development in mathematics teacher education.

## **The case of Oda**

The following example is taken from an inquiry carried out throughout two consecutive semesters at a Norwegian university. Twelve PSTs were asked to create a resource bank for teaching mathematics as part of their coursework in the teacher education programme. The Norwegian teacher education is a five-year programme, resulting in a master's degree. In their fourth year the PSTs choose a specialisation. The participants in this study were in their fourth year and specialising in didactics of mathematics. Moreover, they had prior experience from both courses in didactics of mathematics and school placement periods. During the first semester, four seminars were held where the PSTs could

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<sup>1</sup> The notion of object is used in two distinct ways. To make this clear, 'object' with a lower case 'o' is used when referring to "available objects" (in a resource sense), and 'Object' (capitalized 'O') is used when referring to intended outcomes.

work on their resource banks, interact with each other, discuss and ask question.

When the task of creating the resource bank is presented to the PSTs at the beginning of the inquiry, the ZFM and the ZPA overlap to a large extent (related to how the task was introduced). What is promoted is also what is permitted at the time. The task is part of their coursework and is graded as passed/not passed, thus, they cannot choose not to engage in the object promoted within the (initial) ZPA. Nonetheless, the boundaries of the ZFM are explicitly presented as being open to change based on the PST's influence and personal goals. In the following example, a PST named Oda begins expanding the ZFM in line with her own personal thinking as she is experiencing tensions in the zone system. This appears to inspire a change in her schemes for creating the resource bank. The situation takes place in the fourth seminar at the university, before they engage in a longer period of school placement. The author (A) is teacher and researcher. Our conversation<sup>2</sup> starts out with Oda expressing she struggles to take ownership of the task at hand; she feels she is choosing resources at random. This leads me to ask the following:

- A: Well, how do you like to teach?  
Oda: Ideally, I want them to experience stuff. But uhm... I have to start reflecting a bit more on things, because I don't know. Like, I want them to experience, not just [...]  
A: How do you prefer to learn maths yourself then?  
Oda: I'm old school. I can just sit there and, well, work. I don't mind.

The ZPA set up through the seminar promotes reflection [*I have to start reflecting a bit...*] on the PST's own practice and experience. In the excerpt above, Oda's experience as a student learning mathematics does not map onto her ideas regarding her own (preferred) practice as a mathematics teacher (ZPD). On the one hand, she appears to have been content with "traditional" teaching, with the teacher presenting the mathematics and her as a student reproducing it. On the other hand, she later admits she did not necessarily understand what was taught. Consequently, her (past) ZFM regarding learning mathematics is challenged and there is a tension between the ZPD and the ZFM/ZPA complex. Although Oda struggles to identify personal schemes for her resource bank, she emphasises how she believes physical experience can help students learn:

- Oda: But like... When you experience things physically, what you learn sticks [in mind] in a different way than if you just do calculations like a robot. Because then you don't understand – I mean, I have not understood much, because now I have started thinking...so, yeah. I do know what kind of teacher I want to be, like in general I want them [the students] to move and not just be sitting still all the time. Uhm...but in maths, I mean, you do have to calculate as well. But...I guess there are many ways to do that.

Whether the tension Oda is experiencing is a productive tension depends on if it triggers change that aims to bring the zones into better alignment. At this point, Oda has yet to exercise her agency in accordance with her goals/Objectives in interaction with the resource bank. Thus, the process of instrumentation/instrumentalisation has been a bit unbalanced. She does have ideas about what she considers to be good teaching, but this has not yet guided her process when interacting with the

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<sup>2</sup> Transcripts are translated from Norwegian. Analysis of the excerpts were done prior to translation, as translating text involves making inferences regarding the overall meaning.

resource bank. However, in course of our conversation Oda realises she can operate by this scheme [*I do know what kind of teacher I want to be, like in general I want them to move and not just be sitting still all the time.*] when she is developing the resource bank (documentational genesis), and when she looks for and selects resources for her teaching. In the focus group interview (at the end of the semester), Oda reflects on our prior conversation:

Oda: Uhm ... so not that I have figured anything out, but it was interesting to become more aware that, in a way, it is all connected. What you want to do with the students in connection to what tasks you find, and who you want to be as a teacher, and all that I mean, it's all connected.

The actions promoted in the seminar helps Oda expand the ZFM, and her schemes for the resource bank start to evolve. Accordingly, this is a productive tension as the ZFM changes to match the ZPD causing better alignment within Oda's zone system.

## Summary

For the purpose of exploring the potential of a resource approach to mathematics teacher education, the documentational approach to didactics and Valsiner's zone theory have been combined in line with the networking strategies presented by Prediger et al. (2008). The two approaches are united regarding development; development takes place as teacher's take part in a practice, interacting with the environment, the people in it, and a variety of (cultural) resources therein.

The combined theoretical framework presented in this paper provides a tool to discern and a language to discuss PST's professional development in interaction with resources for teaching mathematics. As demonstrated above, DAD details the relationship between the PSTs and the resource bank as an ongoing documentational genesis. The contribution of the ZFM/ZPA complex is that it articulates how the documentational genesis connects to and is influenced by the different contexts relevant to the PSTs. Furthermore, the framework proffers the opportunity to study agency in (pre-service) teacher development.

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