



INTERTWINING TECHNICAL AND EDUCATIONAL CHANGE WITH TEMPLATES IN A VIRTUAL LEARNING ENVIRONMENT

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ABSTRACT

Within NHL Stenden University of Applied Science, a choice for a new virtual learning environment was made in mid-2021, primarily on policy and management grounds. Early in the migration process, it became clear that this approach could perturb the further rollout of the Design-Based Education (DBE, <https://edu.nl/mwp8j>) educational concept. Four templates were developed to intertwine technological and educational processes that structure different ways of "blended" learning and teaching within DBE. Initial user experiences show that the templates' structures help teachers reconsider online learning activities to shape and facilitate blended DBE learning processes.



INTRODUCTION

Design-Based Education (DBE, <https://edu.nl/mwp8j>) is the principal educational concept of NHL Stenden University of Applied Sciences (Geitz & de Geus, 2019). This innovative constructivist concept promotes multidisciplinary thinking and action, contains an international orientation, is grounded in Design Thinking (Rauth et al., 2010), and encourages personal leadership and sustainable education. Key concepts are learning from real-world experiences, learning from and with each other, and attention to personal and professional development. Design-Based Education works cyclically in six phases, see Figure 1, and takes place in an atelier.



Figure 1, Design-Based Education cycle

The DBE approach requires teachers within the university to promote student knowledge and skills through collaborative learning processes (Assen, 2020). Teachers struggle with this new approach.

With blended forms of DBE, an additional challenge is to perform parts of these collaborative learning processes online. Ongoing support is available within the university, but it needs to be more cohesive. From the Office of Education, Research & Internationalization (OO&I), an "Atelier Blended Learning" was formed in mid-2021 to unite support on blended learning for teachers in one place. In this open atelier, teachers from different academies work together, as well as staff from the internal training service, My Academy, and ICT administrators.

At the same time, the contract with the University's virtual learning environment (VLE) Blackboard Original expired, and a tender was required for a new one. The outcome of the tender was Blackboard Ultra. Subsequently and a vigorous migration



process was initiated. Although the name suggests otherwise, the two virtual learning environments differ considerably in how they facilitate the learning processes. The former Blackboard Original allows instructors to tuck the information away in folders within folders, etcetera. The new Blackboard Ultra has only three levels, forcing instructors to change the data structure. Changing this structure also forces teachers to rethink the student learning process and, more explicitly, design which learning activities occur online and which occur face-to-face. A combination with the educational concept, DBE, may also be part of this rethinking process.

When educational and technological change co-occurs, both come together in a teacher's sphere of work and might influence one another. This can be an uncertain time for teachers with an opportunity for change.

When the migration to Blackboard Ultra was technically underway, participants of the Atelier Blended Learning were more involved in the migration of Blackboard Ultra. At this time, the group was working on a definition for Blended Learning for the university and was looking for a way to support faculty in forming "blends" appropriate to DBE.

A search through existing policy documents and background on DBE led to two key articles: Kurtz and Snowden (2003) and Cronjé (2020). Kurtz and Snowden (2003) set forth four different views of knowledge utilization and call them: Known, Knowable, Construction, and Chaos, see Figure 2. Cronjé (2020) describes four different approaches to learning: Injection, Integration, Construction, and Immersion, see Figure 3.

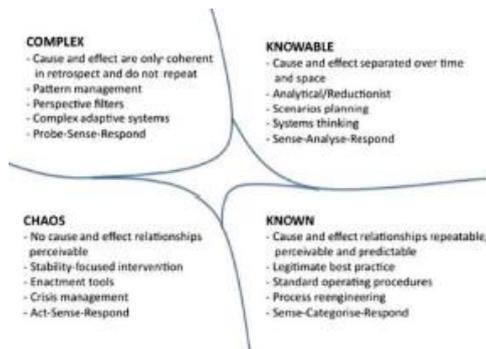


Figure 2, Different knowledge approaches (Kurtz & Snowden, 2003, p. 464)

Constructivism	10	Construction	Integration	Objectivism						
	9									
	8									
	7									
	6	Immersion	Injection							
	5									
	4									
	3									
	2									
	1									
0	1	2	3	4	5	6	7	8	9	10

Figure 3, Four educational approaches (Cronjé, 2006, p.392)

Cronjé then superimposes the four approaches to learning over Kurtz and Snowden's (2003) four knowledge approaches and illustrates the differences between the approaches with pedagogical (methods) and technical (technologies) examples, as seen in Table 1.



With this matrix, Cronjé clarifies that different learning approaches are related to various activities and digital tools. This matrix also explains how definitions of blended learning from other universities might not fit NHL Stenden. The social constructivist approach of Design-Based Education fits better with Kurtz and Snowden's (2003) complex knowledge approach, and Cronje's (2020) Construction approach to learning than with the more commonly Known (Kurtz & Snowden, 2003) and Injection (Cronjé, 2020) approaches.

Within the university, all four approaches to learning occur. We see the Immersion approach primarily in internships. We see the Injection approach in lessons, lectures, and workshops emphasizing subject matter content and tests. We see the Integration approach mainly in situations where students practice skills, compare and analyse information from different (professional) sources, and discuss and puzzle with each other. What distinguishes the Integration from the Construction approach is that for the former teachers know the correct answer in advance, while for the latter, many answers are possible.

Table 1 Four different approaches to knowledge and learning require different pedagogies and the use of digital tools (Cronjé 2020)

Context (Kurtz & Snowden)	Theory (Cronje)	Methods	Technologies
Known	Injection	Tutorial Drill	Lecture Book Video
Complex	Construction	Construction Exploration	Open-ended learning environments Construction kits and tools Spreadsheets
Knowable	Integration	Puzzle Discussion Debate	Games Discussion tools
Chaos	Immersion	Experience Field trip Apprenticeship	Blogs Logbooks Assessment tools

From the observation that four different educational approaches are recognizable in practice, though not mutually exclusive, Cronjé (2020) substantiates that a definition of blended learning should include clues regarding educational context, theory, method, and technology.

Because all four approaches are recognizable within NHL Stenden, the Atelier blended learning established the following working definition for Blended Learning:

At NHL Stenden, we interlace face-to-face and online learning environments to enrich and optimise student learning within Design Based Education. We make sensible use of digital tools to enrich inclusive learning and make learning and teaching more efficient.



This definition offers room for all four of Cronjé's different approaches to learning to shape their blend. This definition and the insight that every approach to learning requires its own blend also influenced the migration process from Blackboard Original to Blackboard Ultra.

Based on good experiences at other universities worldwide, the supervisors from Blackboard suggested supporting teachers during the migration to the new VLE with the help of a template. A template gives teachers a start to work with instead of an empty space.

Several online sessions took place with administrators, technicians, and educationalists of NHL Stenden to determine what the template for NHL Stenden might look like. It became immediately apparent that the templates proposed by Blackboard emphasized structuring subject matter content and tests. As such, the proposed templates revealed an objectivist approach to learning consistent with the quadrants "known" (Kurtz and Snowden 2003) and "Injection" (Cronjé, 2020) and not a constructivist approach desired for DBE.

It became increasingly clear that working with a template can certainly be helpful and give teachers a foothold and some guidance during the design of a learning process and that the unique educational concept of DBE requires its own template. The use of templates with an objectivist approach to learning developed elsewhere perturbs development toward the more constructivist forms of DBE. Thus, the real challenge appeared: creating a template in Ultra that can support teachers of NHL Stenden in shaping blended Design-Based Education.

This design challenge was taken up in three phases. For each phase, different steps of the DBE cycle were followed. The exploratory phase mainly focused on the second DBE step, "determine the question based on knowledge," and also generated ideas and design requirements. These design requirements were the start of the second phase, in which prototypes for a template were developed and presented to a teacher, a lecturer, and an educational advisor. The final phase, researching the effect, is currently still in progress.

The following sections provide further descriptions of each phase's activities using the Design-Based Education steps.

ORIENTATION PHASE

STEPS 1, 2, AND 3 DESIGN-BASED EDUCATION

Based on the design challenge, Cronjé's (2020) matrix was expanded with requirements related to Design-Based Education, see table 4.



This chapter presents an overview of the theory gathered, ideas generated, and design requirements for the template that surfaced during the process.

The theoretical grounding for design requirements of the template

Several prerequisites for the template have been analysed: interactive quality; proficiency level; conversational framework; teachers' technological knowledge; and Ultra. Some theoretical background for each requirement is provided below.

Interactive quality

One of the requirements for DBE is that students work in groups and work with stakeholders from outside the university. A template for DBE in Ultra incorporates items that can facilitate the multidirectional interactions needed for group work. To identify these items for the template, the measure of 'interactive quality' (Roblyer and Ekhaml (2000) was used.

Cronjé's matrix does not elaborate on how the items under 'methods' and 'technologies' shown in table 1 were chosen and aligned with the different approaches to learning. To match the pedagogical requirements per approach to learning with the technical facilities Ultra provides, we used the measure 'interactive quality,' developed by Roblyer and Ekhaml (2000). The measure was initially designed for distance education. It was based on the finding that aligning the direction of interaction and the number of people involved, pedagogically and technically, was a critical success factor for online learning. The measure is not confined to distance education and can also be used to align pedagogical requirements and technical possibilities for blended learning.

The measure 'interactive quality'(Roblyer and Ekhaml (2000) has five levels that run from broadcasting information to mutual interactions among teachers and students and with external experts involved in the learning process, see Table 2.

Roblyer and Ekhaml (2000) state that in online education, the digital tools deployed must be capable of facilitating the pedagogically desired interactions. After all, if the digital tool chosen does not facilitate these interactions or facilitates interactions in a different way than intended pedagogically, the constraints of a digital tool determine the pedagogy rather than the teacher. It might seem like a matter of course that teachers choose digital tools that meet their pedagogical requirements. In practice, however, "mismatches" between the two frequently occur (Almås & Krumsvik, 2008; Pareja Roblin et al., 2018).

Many experts emphasize that, during the design process, teachers should first determine the content learning goals, then decide which learning activities help



students acquire these goals, and then choose digital tools to facilitate the activities (Laurillard, 2012; Voogt et al., 2013). In practice, however, teachers are only acquainted with a limited number of digital tools (Brummelhuis & Binda, 2017) and are seen to work the other way around (Behnen & Kuijper, 2022). During online learning processes, teachers adapt the learning activities to what they know the digital tools can do. In other words, the possibilities of the digital tools teachers are acquainted with determine what happens pedagogically. It follows that the technical options of a VLE might influence pedagogical processes and that heed needs to be given to how teachers perceive them. A template that aligns the educational concept of the University with the possibilities of the VLE might thus support teachers in designing blended Design-Based Education.

Table 2, Levels of interactive quality (Roblyer & Ekhaml, 2000)

level	Interactive Quality	Ways of interaction
1, very low	Broadcasting	
2, low	Individual communication between two people or one person and a technology	
3, intermediate	In addition to individual communication, small group work takes place with just the group members involved in the interaction	
4, high	In addition to communication within small groups, the groups share their outcomes with the other groups and reflect and comment on each other's work	
5, very high	In addition to small groups sharing their outcomes, outside experts are involved, harvesting information within and outside class and instant sharing of outcomes with all participants	

We analysed Cronjé's (2006) approaches to learning with Roblyer and Ekhaml's (2000) measure of interactive quality. Pedagogically, the 'Construction' and 'Immersion' approaches to learning require all five levels of interactive quality (Roblyer & Ekhaml, 2000). 'Injection' and 'Integration' approaches can make do with the first three levels; see Figure 4.

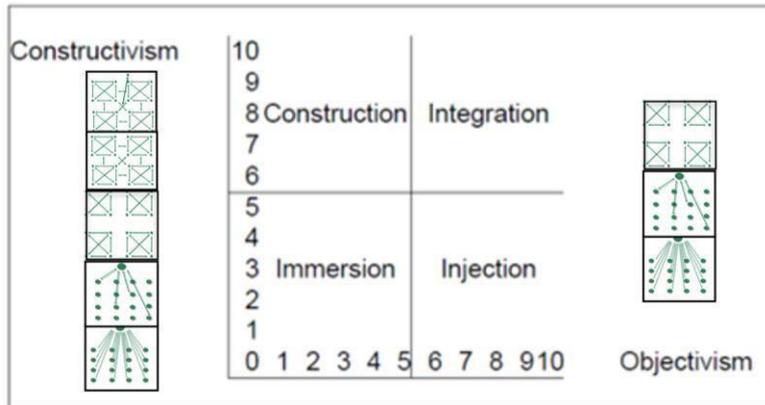


Figure 4, Levels of Interactive Quality (Roblyer & Ekhaml, 2000) for the four approaches to learning (Cronje, 2020)

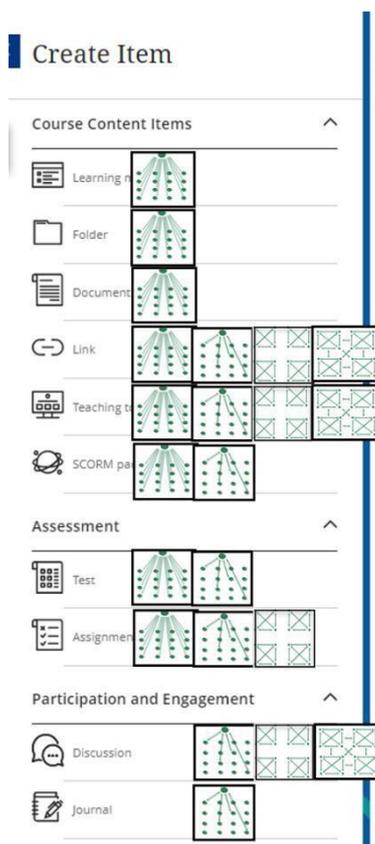


Figure 5, Interactive quality (Roblyer & Ekhaml, 2000) of Ultra features



We did the same for Ultra. Many features within Ultra promote lower levels of interactive quality (Roblyer & Ekhaml, 2000); see Figure 5. Unfortunately, interaction with an external expert, an essential facet of DBE, is not yet possible.

The analysis betrays a mainly objectivist view of the learning of the developers of Ultra. With this analysis in mind, the design challenge can be refined to develop a template with the mainly objectivist features of Ultra to support teachers of NHL Stenden in shaping a constructivist approach to blended Design-Based Education.

Proficiency level

Another requirement we wanted to add to Cronjé's matrix was students' proficiency levels. We analysed Bloom's taxonomy (Anderson & Krathwohl, 2001) and Miller's (Miller, 1990).

Both taxonomies could be linked reasonably easily to the different teaching approaches. Miller's *knows* and *knows how* apply well to Injection and Integration (Cronjé, 2006). Miller's *shows how* is apparent to Integration, Construction, and Immersion, and Miller's *does* to Construction and Immersion. With Bloom's taxonomy, it is possible to link the levels *remember* and *understand* to all of Cronjé's approaches, but are most apparent within the Injection approach. For Cronjé's Integration approach, *apply* and *analyse* are appropriate. In the Construction approach, the mastery levels *evaluate* and *create* are essential for students to self-assess the quality of their work. In the Immersion approach, the ability to *analyse* practical situations and *evaluate* actions is critical to the learning process. The outcome of the analysis was that Miller's taxonomy had a clearer 'fit' with the approaches to learning and was thus added to the matrix.

Conversational framework

Laurillard's (2012) Conversational Framework was already in use for other support facilities within the University. Within the Atelier blended learning team there was a request to connect Laurillard's framework with Cronje's approaches to learning. However, the analysis revealed that this was impossible. All components of Laurillard's conversational framework could be included in all of Cronje's approaches to learning. Also, all levels of interactive quality could occur within each element of Laurillard's conversational framework leaving us with no possibility to differentiate. We, therefore, dropped this requirement.



Teacher's technological knowledge

Another requirement for the template design was the teacher's knowledge of technology. Thus we analysed teachers' Technical, Pedagogical, And Content Knowledge (TPACK; Mishra & Koehler, 2006) needed per approach to learning.

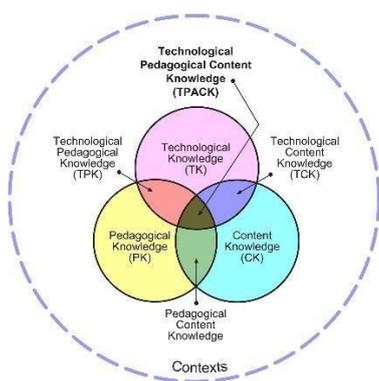


Figure 6, The TPACK-model by Mishra & Koehler (2006)

Within the Injection and Integration approach, teachers primarily combine technical knowledge (TK) with content knowledge (CK) to steer the learning process.

The Construction approach requires more intensive student interaction. Combining technical knowledge (TK) and pedagogical knowledge (PK) is essential. For Immersion, the combined TPACK of teachers is necessary because this approach involves teachers helping students connect practical experience from their internships with theory learned during their training.

Ultra

Finally, the features of Blackboard Ultra were connected to the four approaches to learning according to their interactive quality, as shown in figure 5. All Ultra features can be used within all teaching approaches, but some have a better fit.

In the Injection approach, knowledge transfer is essential, and a clear sequence of files and activities aimed at acquiring knowledge is appropriate. The Integration approach is about solving problems. These problems can be structured in Ultra's assignments. In the Construction approach, Ultra features that facilitate group work and enable discussions are appropriate. For the Immersion approach, all available



features can be helpful. Input for the learning process in this approach is whatever students encounter during their internships. Therefore, Ultra features that can support students in reflecting on their actions, such as a journal, are helpful.

Summary of design requirements and ideas for the template

Based on the above, an overview was made in table 3 of the design requirements and ideas that surfaced.



Table 3, Summary of design requirements and generated ideas

Design requirement	Generated idea
Recognizable and distinguishable for teachers and easy to use	Not all courses within the university follow the steps of the DBE cycle and do not have to. Create a template for these other approaches as well. Cronjé's different approaches to learning also include differences in how teachers and students, students among themselves, and students with outside experts work together. Their manner of interaction differs. Roblyer & Ekhaml's (2000) five levels of interactive quality can potentially help to further identify those differences.
The template helps teachers avoid 'mismatches' between pedagogy and technology.	Based on the five levels of interactive quality, analyse the various "items" within Ultra. Incorporate Miller's taxonomy (Miller, 1990) into the templates. Roblyer & Ekhaml's (2000) five levels of interactive quality have both pedagogical and technical dimensions. These dimensions can be helpful in "matching" the interaction that is pedagogically desirable per Cronjé's (2006) educational approach with what the virtual learning environment Ultra can facilitate technically.
Inspiring, using the templates, teachers can discuss the design of their teaching.	Develop four templates instead of one, using Cronjé's (2006) approaches to learning as a starting point. For each template, select the items that facilitate the interaction required for that approach to learning and build the templates around them.
Supporting Design-Based Education (DBE).	The template to be developed includes the steps of the DBE cycle.
Teachers are allowed, but not required, to use the templates	Practice what you preach: the structure of each template is unique and reflects the respective approach to learning
Bring together information and resources for teachers scattered across different platforms and services on the intranet.	Supplement the templates with information from other fragmented resources within the university.
Discarded ideas	
<ul style="list-style-type: none"> - Develop a template around the five facets of DBE - Incorporate Bloom & Krathwohl's (2001) taxonomy into the templates - Develop a template with Laurillard's (2012) conversational framework 	



Stakeholder feedback

The design guidelines and first ideas were discussed with a teacher, a researcher, and an educational advisor within NHL Stenden.

The teacher:

"What a great idea to use four approaches to knowledge for four approaches to learning and translate them into a template. I Never thought about being able to set up a VLE that way. Brilliant."

The researcher noted that more than one template would be required for NHL Stenden. All four approaches occur at NHL Stenden, and each deserves a template.

The educational advisor:

"We seem to have advanced further with blended DBE than expected."

The educational advisor emphasized that DBE allows room for different approaches to learning. The aim is that about 30% of every study program is organized according to DBE.

With these encouraging responses, it was decided to build four templates instead of one based on the gathered theory.

DEVELOPMENT PHASE,

STEP 4 OF THE DESIGN-BASED EDUCATION CYCLE

The building of the templates took place within Ultra, as seen in table 4.

The templates have been available to teachers since the summer of 2022. When teachers request a new Ultra environment, they are first asked which template they would like to use. There are resources available with which they can make a grounded choice.

Teachers can select one of the four templates, a combined template that includes the content of all four templates or choose no template. With the latter choice, teachers receive an empty Ultra environment.

The templates are for inspiration. Teachers are not required to use them. After requesting a template, teachers can adjust everything to their liking.



IMPLEMENTATION AND TEST PHASE

DBE STEPS 5 AND 6

The implementation and test phase of the templates is currently taking place. We follow how teachers use the templates both quantitatively and qualitatively.

Preliminary quantitative results show that, to date, 115 templates have been requested, 23% of which asked for the Injection template, 7% for the Integration template, 28 % for construction, and 43 % for Immersion.

Some preliminary qualitative results are:

"If I had not seen the possibility of what a template could do, I think I would have gone back to the copy-and-paste activities we were used to in Blackboard Original" MF.

"Thank you so much for these templates and all the resources now in one place," AK.

"So happy not everything has to be DBE," HK.

"Templates are a good idea. We will make our own for our academy," KZ.

"We used the Construction template, and it seems to fit well with what we are doing. Looking back, we found out we did not use the last two steps of DBE the template provides. This was a wake-up call for us... This is interesting because the template helps to design what we have in mind but also helps us keep on track. Yes, I think the template can help to implement DBE" AK.

FUTURE

NHL Stenden has a unique educational concept, Design-Based Education. This requires its own approach to blended learning.

By comparing the interactive quality of pedagogical requirements with the technical features of the virtual learning environment, four distinct templates were developed based on four approaches to learning (Injection, Integration, Construction, and Immersion).

Initial practical experiences with the templates encourage us to continue to develop the templates with more teacher resources. We will also continue to monitor how



teachers adopt the templates and how this can affect shaping blended Design Based Education.

Table 4, a summary of requirements for a template per approach to learning (Cronje, 2020) and prototypes in Ultra



Approach to learning (Grogie, 2020)	Students proficiency level (Miller, 1990)	Teacher's TPACK, (Mishra & Koehler, 2006)	Interactive quality (Roebber & Ekhamal, 2000)	Features of Blackboard Ultra for building the template	Prototypes in Ultra
<p>INJECTION</p> <p>knowledge acquisition & Direct instruction</p> <p>Cause and effect are repeatable, imaginable, and predictable. There are existing practices and standard procedures. In this approach, knowledge about the use of technology focuses on the teacher making information available and the student processing it individually, which can also take place a-synchronously (student can set own pace).</p>	<p>Knows</p>	<p>Mainly TCK, Knowledge about how to present information online.</p>			<p><i>The sequence of material to be learned is visible in the main structure of the template.</i></p>
<p>INTEGRATION</p> <p>Puzzles with correct answers are known in advance. Exercise and exchange through discussions, conversations, and games</p> <p>This approach requires analytical thinking in which cause and effect are separated by time. This involves puzzles and assignments/tasks, of which the outcome is known to the teacher but not to the student. Through this approach, students learn</p>	<p>Knows how and shows how</p>	<p>TCP Knowledge about structuring online learning activities that facilitate students to analyse and discuss resources</p>			<p><i>This template emphasizes analysis and puzzling. Assignments form the backbone of this template.</i></p>



<p>to reason logically and think in systems.</p> <p>CONSTRUCTION</p> <p>Issues from the field and experimentation</p> <p>This course focuses on exploring and exploring complex issues from the field in iterative cycles (Geitz & de Geus, 2019). Students learn by doing, experimenting, and making mistakes. All stakeholders, students, teachers, and experts participate in this collaborative learning process.</p>	<p>Shows how + Does (under guidance)</p>	<p>TPC Knowledge about facilitating group interaction and work online (Hettink et al., 2016)</p>			<p><i>The steps of the DBE cycle form the basis of this template.</i></p> <p><i>This template is the least filled. The recommendation is to match what students need closely. They may therefore be given teacher rights in this environment.</i></p>
<p>IMMERSION</p> <p>Practical experience, stepping into the unknown, experiential learning, and internship. Experiential learning in a real-life situation</p> <p>In this approach to learning, There is no predictable relationship between cause and effect, and interventions aim to gain stability and grip. This is where most theories indicate that real learning takes place (e.g., Shipley 2017). Examples of learning activities within this quadrant include field trips, internships, and authentic life assignments.</p>	<p>Does (independent)</p>	<p>TPACK Knowledge about adapting technological needs to the learning process as it unfolds.</p>		<p>For this approach, a sound portfolio system is also needed.</p>	<p><i>This template is the least filled. The recommendation is to match what students need closely. They may therefore be given teacher rights in this environment.</i></p>



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