Implications of the adoption of a concept-based approach to instructional design (Efficiency of authoring adaptation for existing course material)

This section reports and interprets the attempt of a teacher to turn his existing course into an adaptive version of it, thanks to the use of a tool called Grapple. The qualitative study documents encountered difficulties and time needed at each step. In addition, it provides insights about the conditions of acceptance by practitioners of tools designed to help them to personalize learning material.

1.1.1 Introduction

Personalization of learning has become prominent in the educational field, at various levels: social (Bonal & Rambla, 1999), government policy (DfES, 2004; Leadbeater, 2004), school management (Lambert & Lowry, 2004; West-Burnham & Coates, 2005) and course/lesson design (Martinez, 2002; Polhemus, Danchak, & Swan, 2004; Tomlinson, 1999; Weller, Pegler, & Mason, 2003). However, how individual instructors reverberate this call for "personalized learning paths" in their practice is not investigated to a large extent, especially in distance education. The difficulty partly stems from the relative scarcity of adaptive educational systems currently in use. Furthermore, those personalized learning platforms based on adaptive philosophy are seldom tested, remaining small scale and mainly as experimental set-ups. It goes without saying that this relative poverty leads to a very modicum of empirical investigations (Weibelzahl, 2005) which would demonstrate that most effective learning is achieved or facilitated thanks to such systems (Ronen, 2006, p. 19). Matan & Aviram (2005, p. 8) note in addition that research in adaptive systems has still not yielded a scientifically corroborated set of methodologies to support personal learning and is flawed at an upper level by the lack of validated personalization theories). Even prior to such assessment of the pedagogical return on investment in personalisation, it sounds reasonable to listen to teachers as first-line agents of the personalisation process. The Grapple project gave an opportunity in this direction.

1.1.2 The Grapple tool

GRAPPLE project aimed "at delivering to learners a technology-enhanced learning (TEL) environment that guides them through a life-long learning experience, automatically adapting to personal preferences, prior knowledge, skills and competences, learning goals and the personal or social context in which the learning takes place. The same TEL environment can be used/accessed at home, school, work or on the move (using mobile/handheld devices). GRAPPLE will include authoring tools that enable educators to provide adaptive learning material to the learners, including adaptive interactive components (visualizations, simulations, virtual reality). Authoring includes creating or importing content, assigning or extracting meaning from that content, designing learning activities and defining pedagogical properties of and adaptation strategies for the content and activities. To ensure the wide adoption of adaptation in TEL GRAPPLE will work with Open Source and commercial learning management system (LMS) developers to incorporate the generic GRAPPLE functionality in LMSs. Evaluation experiments in higher education and in industry will be performed to verify the usability of the GRAPPLE environment (for authoring and delivery) and to verify the benefits of using adaptive TEL for the learning outcome". (GrappleProject, 2007, p. 5)

1.1.3 Questions

This pilot provides considerations on how an average practitioner gets the grip on the Grapple tool when he wants to use it to equip a non adaptive pre-existing course with some degree of adaptivity. How does he grapple with the very practical demands of this process? Will he find it easy or difficult to apply, long or short to complete? Will there be any discrepancy between how the developers of the tools have thought that it would be used and how it is actually used by this average teacher? How will the balance time/added value look like in his eyes? These critical questions address the relevance of the Grapple tool for the "real-world of education".

1.1.4 Setting

1.1.4.1 The method

The study uses a diary method whereby the teacher keeps a journal of his experience with the Grapple tool. A final discussion supplements the investigation. It is used to shed additional light on the transcripts. This pilot opts on purpose for a qualitative approach. The holistic inquiry, conducted with the diary method, offers

valuable contrast with analytic evaluations carried out on specific dimensions of the Grapple tool. Its naturalistic nature (Guba & Lincoln, 1985), wherein researchers choose not to control variables and try to mediate as less as possible, also aims at being very close to the daily work of an instructor. Despite the limited and rather unstructured type of data gathered, the method nevertheless offers advantages:

- it helps gaining familiarity with the dimensions of a phenomenon (Miles & Huberman, 1984), here the perceptions of a practitioner towards a tool designed to ease the design of adaptive teaching and learning;
- it may reveal aspects of the phenomenon that observation could never have captured, and that no one would have thought of including as questions on a questionnaire (Allwright & Bailey, 1991);
- it taps into the realms of cognitive, social, and affective processes and try to get at the meaning given to these events by the participants themselves (Clarebout & Elen, 2006);
- it increases and contextualises the value of the information collected through regular form of evaluation. Narrative information carries a lot more weight and things to discuss. The need is for more context. (Schwandt, Lincoln, & Guba, 2007).

1.1.4.2 The teacher

The teacher volunteered for this pilot at the end of a first Grapple training that took place at the Open University in the Netherlands. He expressed interest for personalized learning and for the Grapple project. The teacher had also a real-world quality course that he was willing to use for this phase. The teacher had no technical background though he was used to authoring on eLearning platforms.

1.1.4.3 The course

The course is called “Seks en de evolutie” (Eshuis & Goltstein, 2007). It is an OpenER course in Dutch, part of the openER programme of the Open University in the Netherlands (Schuwer, 2008). The course consists in 7 chapters composed of threshold content and of extra content (defined as elaborations and not as superfluous material). The course is illustrated with very finely selected static pictures. The course is intelligently crafted and is a trial to demonstrate that science may also be a “sexy” and tied with daily experience topic. The course has 105 pages. The course ends up with a MCQ test of 16 questions tapping both into threshold and extra content.

1.1.4.4 The task

The teacher received access to the Grapple environment. The assignment was to migrate his existing course to Grapple and to equip this course with adaptive rules. The teacher was asked to hold a detailed run-time diary of his experience with the tool and to express anything he considered worth saying regarding this authoring experience. A short training-session was given to the teacher in order to make clear and to familiarize with the permanent crisscrossing between actions with Grapple and the note-taking process. The teacher was asked to leave a minimum time lapse between the behavior/thoughts/feelings episodes in the tool and their reporting in diary. The teacher was given a last piece of instruction: to segment (in- or post- practice) the authoring process with as many sequences he would find meaningful. The teacher was invited to make screen captures that would seem appropriate to illustrate any of his reflections. The teacher was told that his comment would help to improve the tool and its use by other teachers.

1.1.4.5 The data

In total, the diary consisted of 10 Word bulleted pages (including 14 screen captures) Word document), mostly written in an "I form". The 97 entries were divided by the teacher into 6 main sections.

1.1.5 Results

This section stays as close as possible to the teacher’s diary. The researchers have converted it from its initial “I” form to an impersonal description for the reasons that:

- it fostered a first objectivation of the data;
- it allowed the researchers to intersperse, without style breach, teacher’s comments with additional information deemed to provide better context for the understanding of the teacher narrative;
- it contributed to the “reduction” phase (Miles & Huberman, 1984) by giving the opportunity to wrap-up perceptions that the teacher sometimes describes in several annotation.

Additionally, teacher's comments addressing purely technical interface problems were removed.

The organization of this section respects what the teacher described as the major stages of the authoring process. Teacher's comments are given in italic. The analysis and interpretation of the teacher's comments and attitudes is left for the next section.

Quotes from the teacher's diary are marked with italics.

1.1.5.1 The Mindmeister map as a preliminary step

The observed teacher had received a training in the grapple tool. Based on this experience he found that a more flexible tool was needed to get a visual full picture of the course and its concepts. He opted for the mind-mapping suite Mindmeister (www.mindmeister.com). He created a large map with several color codes that served as a reference concept structure that he described as a "*visual and enriched table of content*".

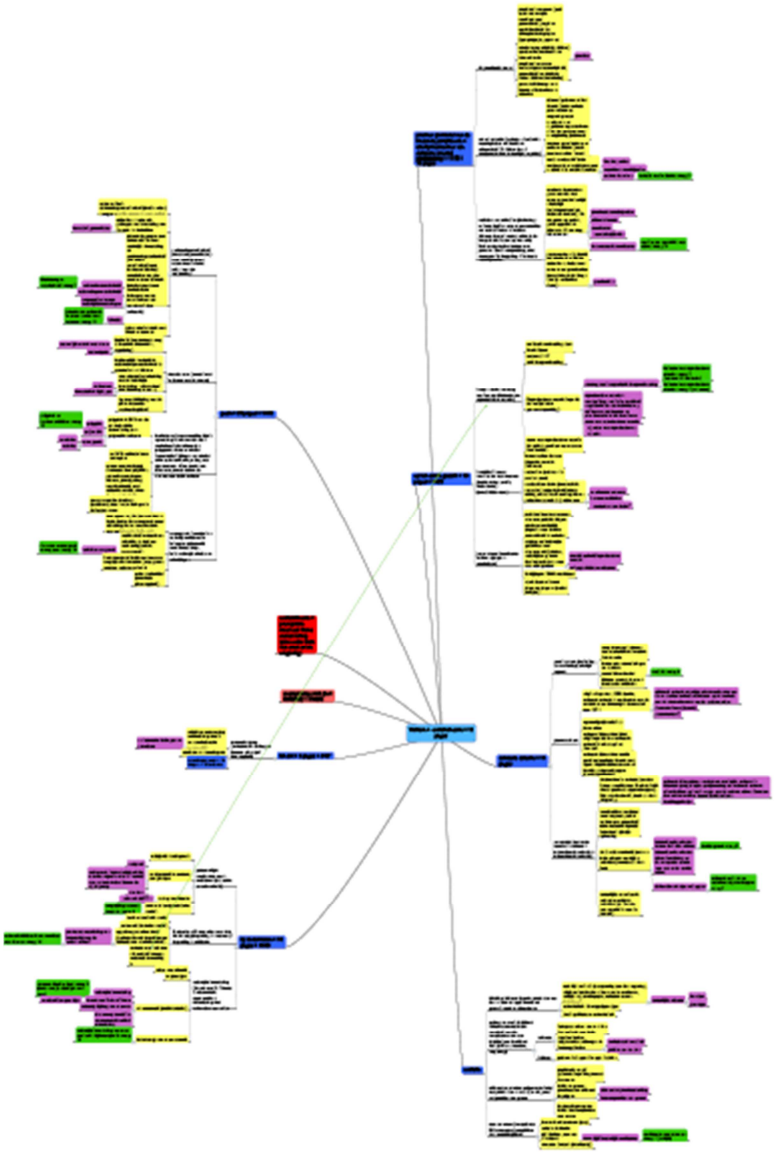


Figure 1. The teacher's reference map

The colors highlight threshold pages, extra content, important pages and test questions. This stage was judged as necessary by the observed teacher:

to enhance his detailed mastery/ownership of the content domain. This might seem strange as the teacher knew the course quite well beforehand but he explained that: "*I realize that my knowledge is global. Yet, this approach imposed to me seems, to be effective, to require a detailed mastery of the distribution of the concepts per page as well as the possible links between pages. Adaptive rules require such a fine-grained mastery. Moreover, 105 pages is a heavy number and the titles of each does not necessarily reflect the whole content. For each, I add a short summary. Another thing is necessary: to know on which page(s) the*

answer to a test question is given. Yet, I cannot take the risk that a student receives a test question for a content he did not cover through his personal learning path";

- to get used to the analytical approach in separate concepts and relations;
- to bypass limitations of the Grapple environment, perceived as more powerful but less flexible. The teacher especially put emphasis on the advantage of having "*everything on a single page*".
- to flag the relationships, redundancies, transversal or local concepts.

The teacher also stresses that a concept-based approach was totally new (and awkward) to him. Mindmeister, as a familiar, flexible and highly visual tool allowed him to get the grips on this approach and to steadily refine it. It considered Mindmeister as a training or as "*sand box*".

A careful re-arrangment of the existing course. The first building block of the Mindmeister map was a careful re-reading of the pages, a transcription of their titles in concepts boxes and the writing of an associated summary. For this first stage, it must be noted that the map's structure is fully aligned on the structure of the course.

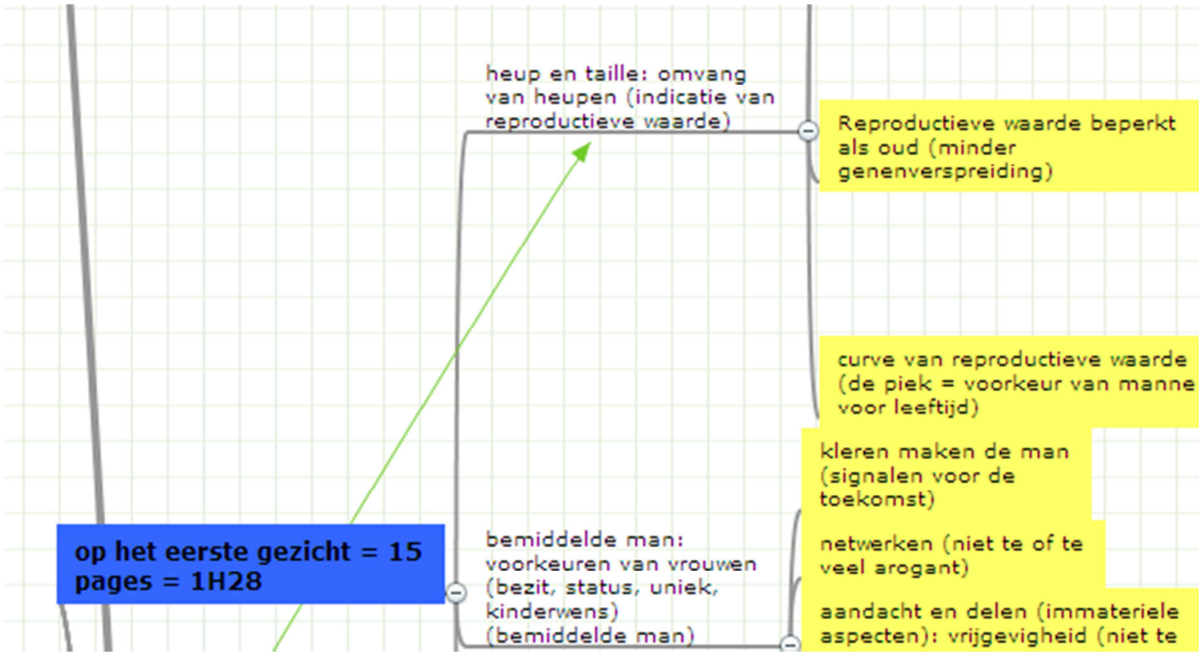


Fig. 2. A first map aligned on the course's pre-existing structure (in blue, the chapters, in yellow the main ideas for each page)

The teacher was asked to indicate how much time he took for this first stage. Results are given in the table below. It must be reminded here that the teacher is not the course author. It is quite likely that the real expert domain would have taken less time for this reading/summarizing phase. Interestingly, the teacher noted in his diary: "*I was not the content expert but I have the feeling that through the mind-mapping process, I grew up to this status*".

	Number of pages	Time for the loosely Mindmeister concept mapping
Welkom	4	5'
Evolutie	18	1H50
Op het eerste gezicht	15	1H28
Bij nader inzien	15	1H40
Seksuele selectie	14	1H31
Pronken	13	1H43
Gezin	20	1H46
Tot slot	4	6'
Total	103	10H15

Table 1. Time spent on the reference map per chapter of the course

Extraction and display of embedded concepts. The second action consisted in the extraction and the transcription of concepts for each content page (purple boxes).

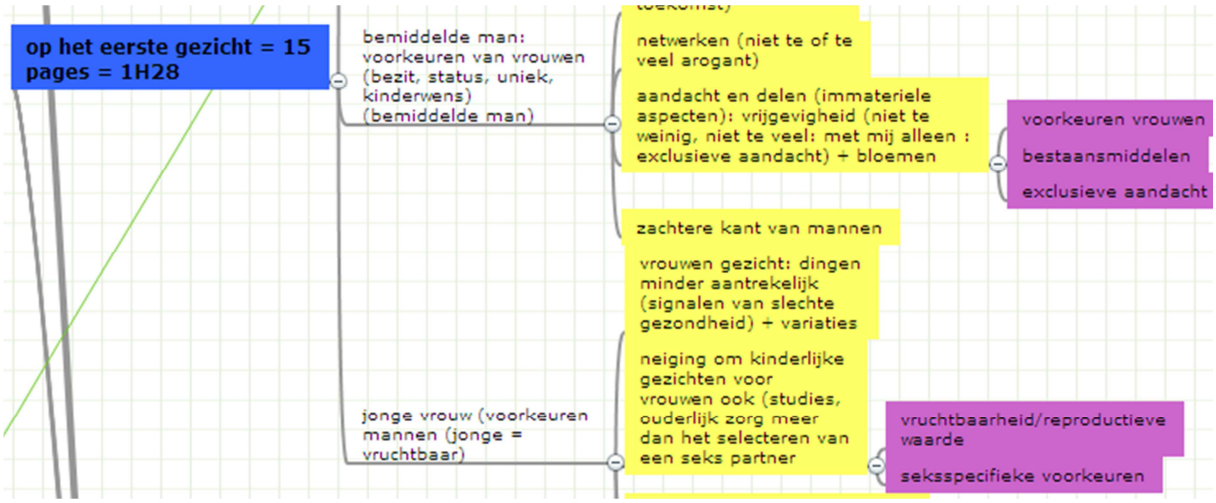


Fig. 3. In yellow, the main concepts for each page of the pre-existing course

It is not obvious to understand why the teacher separated the reading/summarizing from the concept extraction/transcription. It seems that a first reading of the whole concept was a pre-condition to know exactly which concepts were prominent. This phase took the teacher 2H50'.

The link resource-assessment. The teacher took 1H10 to relate the test questions to the content pages containing the information needed for a right answer (green boxes).

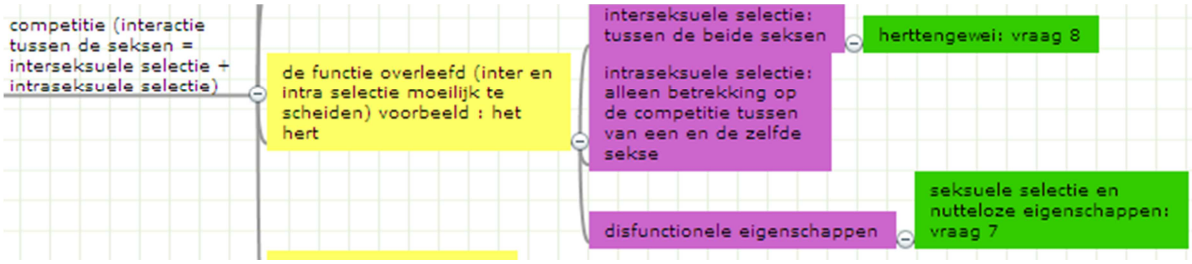


Fig. 4. In green, the final test questions related to the page of the course containing (part of) the answer

The Mindmeister map does not contain many relationships as if the teacher had left this for the Grapple tool ("*The tool is not just a visual glossary. Its strength and specificity is the indication of relationships*").

1.1.5.2 The Grapple tool

1.1.5.2.1 Phase 1 – The domain model

Moving from the Mindmeister Map to the Grapple map took 3H16. It lead the instructional designer to the following observations.

From default relationships to labelled ones. At first sight, the offered relationships seem very limited to the practitioner (the drop-down menu offers only three options). "*The relationship forces to establish a rough link where I would expect nuance from the student*". The practitioner also wonders what is the difference between the bottom up relationship (Belong to) and the top-down relationship "is composed by". Should both

always be indicated? Eventually, the practitioner decides to choose just one each time. The practitioner regrets that once the concept is labeled with a pre-defined relationship, no change is possible anymore. An example: “signalen van reproductieve waarde” (plural) could not be modified to “signal van reproductieve waarde” (singular) which would be more logical when the relationship “is a” (singular) is established with instances of such signals. Indeed, the concept can be erased and reworked but when it is already connected to many other concepts, it turns to be a real hurdle. After some time he notices the possibility to label a relationship. However, these labeled relationships cause trouble of their own right: “*I get sometimes stuck with regard to accurate qualifications. The link between two concepts does exist but needs explanations to rightly specify the connection. For instance, I cannot relate in a short way and find the proper wording for the relationship of “polyginie” and “polyandrie” to “monogamie*””..

Concept or content?. 1. The practitioner was first tempted to take the title of the course chapters as concepts but realized that it would not work and that it was not the intention underpinning the tool. It was one major change of mind. But this switch of logics brought uncomfortable uncertainties. What was initially separated for the sake of the learning rhythm and cognitive load had now to be linked. Interestingly, the practitioner fought against his feeling of being lost or of destructing something well-thought and homogeneous by using the “description” box to indicate the previous place of some concept in the initial structure of the course (“*I link these two concepts but I know that the first one was first covered in chapter 2*”).

2. The first move of the practitioner was to give a definition for each concept. It stopped because this is a huge work and because some terms that ought to be visible in the concept maps are not genuine concepts (“jongeren jongens”). Actually, the teacher’s diary reveals a dilemma between the choice of putting in the concept domain loosy terms which are not concepts on their own right or to “*leave them to content*”. “Jongeren jongens” for instance, was seen as an “intelligent confirmation” of the importance of the “reproductieve waarde”. Can such relationship be used? Eventually, the practitioner kept it in the domain map with a vague link “is a”.

3. Several times, the practitioner was confronter to problems related to synonyms: “*is it better to label this notion as “leeftijdsgat” or as “reproductieve curve*”*?*

4. The practitioner bumped into difficulties with largely transversal or overarching concepts like “het verspreiden van genen” or “ultimaat en proximaat uitleg”. This type of concepts “*which could be connected to almost everything*” was usually left without any relationship in the concept domain. In a paradox, the most connected concepts are those which are left isolated! They connect to nothing because they could connect to everything. Nothing connect to them because it would not make sense (“*the explanation to justify the link would call for too many elements*”).

5. The practitioner wonders whether important parts of the content (“prehistorie en pil”, “recent fenomeen van geboorte beperking…”) can be turned satisfactorily to concepts. On the other hand, the nuances/explanations needed to specify a relationship made the practitioner ask for a possibility to link groups of concepts. For him, it made more sense to link such global entities than each of their components (for instance “nabijheid” supercedes “mannelijke voorkeuren” and “vrouwelijke voorkeuren” and it is not possible to visually represent this precedence with the two concepts altogether). Interestingly, he sometimes located related concepts close to appropriate “clusters of concepts”, using the proximity as a visual cue for a relationship, which is not intended by the tool. Example: link from “vrouwelijke voorkeuren, materiale/immateriale aspecten/kieskeurigheid” to “ovulatie”.

6. The practitioner says that there is no way to indicate concepts of a similar grain, level or importance or intensity (for instance “ouderlijke investering” and “seksuele selectie” which are key notions in the course). Again the practitioner tries to use the “topography” of the concept domain to create such equivalences (“*I put them on the same line*”).

7. The practitioner has problems with “Darwin” which is strongly related to two concepts. “*But it is not the same Darwin*”, he says. He hesitates to modify Darwin into two concepts referring to two different books but eventually drops the idea.

Good things. The practitioner liked the transparent background when defining a relationship “*because it allows to see which relationship is already worked out*”. He liked also the endless space available for the concept domain.

Usability issues. The teacher runs across some interface technical problems described in the section dedicated to remaining usability problems.

Conclusion of phase 1. When asked about the level of quality he thinks he achieved with the concept domain; the practitioner answered: “*I am not fully satisfied but I stop now because I am a bit bored, because I am happy with this trial but not fully convinced by the approach (so, why invest more?), I do not even have clear cues about what I could do to raise the quality (more concepts? More relationships? More details in the*

qualification of the relationship?), because I think that "flaws" in my concept domain need the next step (the link to content) to emerge. For these reasons, I feel that this is enough at this stage".

As some sort of conclusion, the practitioner states that: "*This concept domain that I created for my students is actually what I would prefer that my students create by themselves*". The practitioner also casts doubts on the benefits that can be brought by adaptive rules in a course which is very strong at helping students to steadily build relationships between its different parts. But this is an empirical question for the learning pilot!

On the whole, the practitioner found the exercise interesting but thinks that he many times had to be compliant to the interface and not the contrary.

1.1.5.2.2 Phase 2 – Adding resources to concepts

The domain model of the course "Seks en de evolutie" is considered as finished by the teacher. It contains 51 concepts. Only 10 of them were populated with relevant resources by the practitioner because the process turned out to be relatively time consuming (see explanations below). This process took 3h54 and brought the following observations and behaviors by the instructional designer.

From uploads in Grapple to uploads in Box.net. The practitioner starts looking whether Grapple tool did offer facilities to upload resources. He hit the button "Import" which seemed to allow him to select an html page but once clicked nothing indicated if/where the document was uploaded. The practitioner was a bit disappointed since the course is composed of about 100 html pages coming from the eLearning platform Model. The course "Seks en de evolutie" contains also many images. The practitioner tried logically to upload or import one of these from his desktop. He got the unclear and frustrating message "Cannot load models of type". The practitioner dropped his idea to import resources into Grapple. He reluctantly decided to use external links. Why reluctantly? Because it forced him to firstly upload his resources to an external website (www.boxnet.com) in order to get a url that he could use for Grapple. Once more, he expressed his feeling that the teacher had to adapt to the tool and not the tool to the teacher. As a first step, in a kind of dry-run test, he uploaded a dozen resources in Box.net. The practitioner faced at this point a problem. When he looked (via the "view" button of the "resource" tag) at the resource he had just linked to the three concepts, he realized that the images on the page did not display due to absolute links. He decided to bypass the problem by making a screen capture of the page with the software Gadwin Printscreen. He uploaded the image of the resource in box.net and linked it to the three concepts.

Inconsistencies?. The first resource, an html page, was an introduction to the course along with a very general reminder about Darwin and the main concepts of his theory. After some hesitations, the practitioner linked this resource to the concepts "Darwin", "Selectie" and "Natuurlijke selectie". Its hesitations came from the fact that the resource is sharpened like an introduction to the course. He then wondered what would be the impression on a learner who would access this resource after having already worked in the course ("*even if this tool tries to limit the linearity, there can remain a necessary order*").

Vocabulary of the interface. In the resource documentation interface, he clicked on add (asking why the field "property name" and "value" could not be displayed straight) and entered the data. The practitioner could understand why a "name" ("not a property name") had to be given to the resource but not a "description" libelled as "Value" ("Value of what?"). He also found a bit tricky to give a name since the same resource was relevant for three concepts. The practitioner spontaneously clicked on "Add" and saw what he had just entered vanish. For the following operations, he kept in mind that he had first to click on "Save". He nevertheless show some irritation when the name did not display in the field "Properties" after the click ("*And why "properties" by the way if this the "name" or more exactly the "property name". As for me this is just a resource and his name on my computer is "evolutie 1"*"). He found the just encoded resource in the drop-down menu and clicked on the bottom "Save" button. He viewed the resource and was satisfied.

One move for two concepts? The second resource was linked to the twin concepts of "aanpassing" and "selectie druk". The practitioner raised the issue of linking the same resource to two concepts in one move. As he did not find this option, he uploaded the resource for the two concepts. After the first concept, he was a bit taken aback of not being proposed the resource in the drop-down menu and of being obliged to redefine it.

Research in the domain model? The third resource ("fenotype en genotype") requested to come back to the mindmeister map. Yet, if this resource went obviously along with the concepts "fenotype" en "genotype", as displayed in the domain model, it contained also links to a third concept that the practitioner could not remind of ("*I could read the page again but it will take less time to have a look at my initial work*"). The concept was "seksuele dismorfism" and the link to the resource was added. At this occasion, the practitioner regretted that no search was possible on the visual concept domain.

Visual cues. The practitioner said it would be helpful to see visually which concepts have already received resources.

Conclusion of phase 2. From this phase, the teacher mainly reminds back-and-forth moves between his resource file, Gadwin Printscreen, Grapple, Mindmeister and Box.net in order to add resources to other concepts. After 6 more resources, the practitioner left the computer in order to ask a secretary to take care of the screen captures and uploads on box.net. The practitioner never came back. We are still waiting him.

1.1.5.2.3 Phase 3. The long way to the student's view

After encouragements, the practitioner comes back and wants to see how the course looks like from a student viewpoint (concepts and associated resources).

Switch to student's role. The teacher displays the domain model. He deplores again that the map does not provide any visual cue regarding the resources attached to a concept node. He looks for a "switch to student role" facility like in Model but he cannot find. This request is intriguing for the researchers used to thinking immediately in terms of adaptivity and to seeing the value of Grapple in the tailoring of such an adaptivity. Here, the teacher seems interested just to see the result of his work as a student. In the debriefing interview, the practitioner will give two reasons for this: 1) he wants to see whether he already has something concrete and potentially useful in the context of course. He seems to need some kind of warranty that the next step (the creation of the pedagogical rules) will be based on something which is duly in place ("*was it worth working so far ?*") 2) he gives the impression that he could already make something pedagogically valuable with the mere domain model (see same kind of observation in Ainsworth and the Redeem adaptive system). He makes a last trial by clicking the "deploy" button in the file menu but in vain.

Help? The teacher is a bit confused and decides to visit the "help" menu. He observes that on his browser (Chrome) no illustration is visible which makes difficult to pinpoint the next step. The teacher flips through different pages. He rightly feels that something is missing in the process. He reads the pages about CRT. He has the idea that this missing thing is the CRT ("*yes, Grapple is about adaptivity, isn't it?*"). He concludes that he now has to create pedagogical rules before he can see the course in the eyes of the students ("*it must be a pre-condition*"). He finds in the "help" menu a description of various adaptive rules and reads them. His question is now "how to create one adaptive rule?". Why one? Because he has still in mind to see the work he did so far from a learner's viewpoint. This sounds like a pre-condition before going further.

Conclusion phase 3. The diary delivers this sentence: "*at this point, my goal was just to get rid of this apparently compulsory condition to create an adaptive rule. I wanted to create just one rule and to access to my domain from the learner's viewpoint. This is probably a wish to get quickly a vision of the whole process before coming back to this or this specific action. It was the same in the previous phase: it has been hard for me to create the whole domain in a single effort. I need beacons and reinforcement on the road*".

1.1.5.2.4 Phase 4 – Grappling with the adaptive rules

Being sure now that the creation of adaptive rules ("*is one enough? I hope that not all concepts must be related to each other through such a rule because it would be a heavy, heavy work. Moreover, I'd like to see the effect from a student's viewpoint with a limited number of rules*"), the teacher goes back reading the predefined strategies described in the "Help". The diary reflects that the teacher spent about 50 minutes figuring out the described strategies. These are his main comments on each one.

Strategy Visited. "*Can I see the number for a defined student? The text says that the number is stored but where?*"

Strategy Visited to knowledge. *"Is it possible for me and for the learner to visually see an increase in knowledge on the domain model?". "It is said that the increase of knowledge can also be measured via test or questionnaires but I have not yet understood how the Grapple tool allows to make assessments and to use the scores for adaptivity".*

Strategy Knowledge propagation. "*Interesting idea but I have my doubts that its baseline assumption is correct. I think that a student might understand the concept of "fobieen en reflexen" without necessarily be able to link them clearly enough with the concept of "evolutionair voordeel" (well possibly yes because these concepts are very closely linked) or with the concept of "genotype" which is linked but from a bit further. Actually, it questions my domain model from a different viewpoint. I created it to illustrate the relationships between concepts from an abstract viewpoint without considering if these relationships were the same in temps of knowledge. Indeed these concepts are ideally interrelated but it does not mean that disaggregated knowledge of them ("pockets of knowledge") is not possible".*

Strategy Prerequisite: "OK. Nice".

Strategy Concept recommendation. "*It becomes complicated. Does it mean that I have to define first requested values of knowledge with the previous strategies and subsequently use this one to attribute the concepts displayed or not? Won't it be easier to visually show in the domain model of the user (with colours for instance) which concepts are sufficiently mastered, which ones need more training and which ones are not yet available?. But OK, I see, this is about making links visible or not*".

Strategy Parent. "*Is this really about the definition of the pedagogical rules or about the domain model construction?*".

Strategy Guided tour. "*Fine. Very clear*".

Conclusion of Phase 4. A final question of the practitioner is: "*do I have to chose one strategy for one domain model or can a domain model have several strategies built inside? Let's try*".

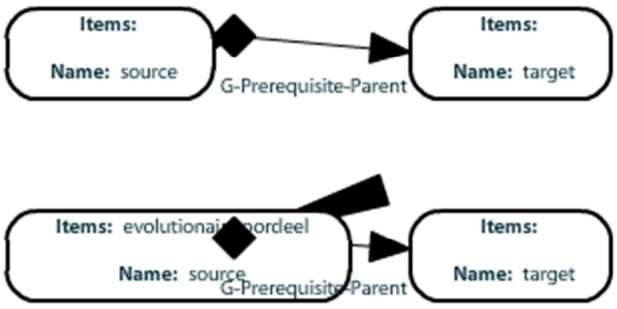
1.1.5.2.5 Phase 5 – Trying out the adaptive rules

After many trials and errors to find the "*base-camp*" of the adaptive rules fixation, the teacher eventually goes in the right box of the Welcome page.

Vocabulary inconsistencies. He creates a "course" ("*but how will it be related to the domain model*") called "evolutionaire voordelen", "because he wants "*a small-scale first trial in order to see how it works*". The teacher seems rather confused about the necessity to "create a new course". For him, the course is already present from the stage of the domain model. He nevertheless does the action and gets the "create a new course" dialogue panel. The practitioner wonders what he could "import from file". "*Anyways, the "browse" button does not work*". He "starts editing". He is surprised not to find exactly the names of the strategies he has just acquainted with in the help menu ("*Am I really at the right place*?").

Fig. 5. Inconsistencies between the help file and the interface

G-Prerequisite-Parent. "This probably matches "Prerequisite" and "Parent" strategies but why are they here proposed in combination while the help explains them separately?". The teacher does not find the drag-and-drop very smooth but "this is a detail". He wonders why the black diamond is inside the box in the first place and outside afterwards, once he has moved the box. He clicks on the "source" box and find the steps of the process quite logical though he questions whether it could be done straight on the domain model. "It forces me to back and forth moves between this tab and the domain model tab". He does not understand why the concepts are not listed in alphabetical order. The teacher appreciates the easiness of the process deletion of any rule. He picks up "evolutionair voordeel" as a prerequisite for "fobieen" and tries to set up this relationship.



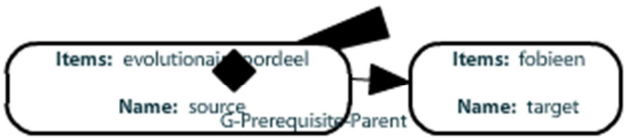


Fig. 6. First adaptive rule with surprises regarding the visual evolution from step 1 to step 2

"*What is "level-float-80? Do I have to do something therewith?*". The teacher gets this pop-up. "*I am not sure I understand this message…*"

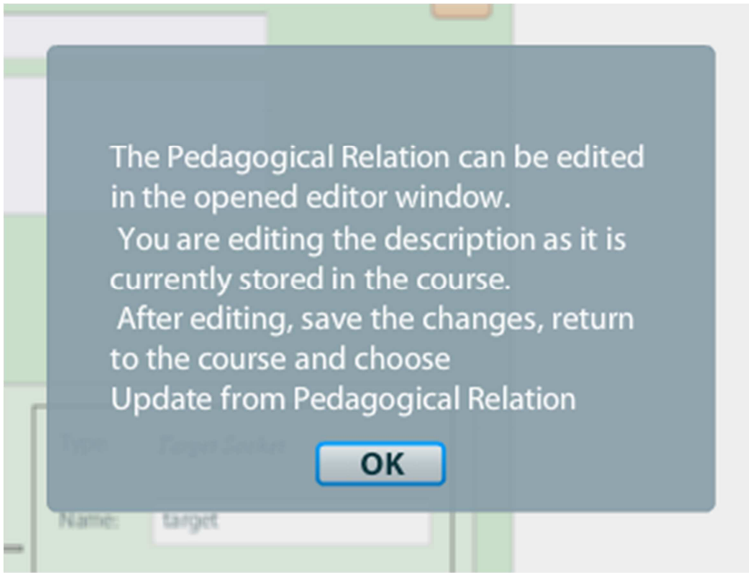


Fig. 7. An message impenetrable to the practitioner

The teacher wonders whether he should replace the source and target with the concepts he is working on. He also tries to figure out what min and max cardinality are ("levels of knowledge?") but in any case nothing can be changed in the drop-down menus. The other tabs are "*fully impenetrable*" and clicks around on "new" do not send any useful information about what is expected here and how these interfaces are linked to the two worked concepts. The teacher also ask whether anything must be saved and how. He eventually finds a "save" button in the tab "debug". He comes back to the course and sees that nothing has changed.

G-quiz. This option conveys only questions: "*is it the place where I create the quiz or where I define the acceptable scores or what?*"

G public knowledge update. The teacher cannot connect the "G public knowledge update" to anything seen so far.

"G-layout". The teacher does not remind this from the help menu.

G-start. "*That must be the fist concept presented to the student. I want it to be "evolutionair voordeel". But the "click to edit*" does not work. After a few trials, the usual panel displays and he can select the concept and the word appears in the g-start box after a few seconds.

G-visit. "*Let's see if G-visit is the guided tour or one of the two "visit" strategies*". The drag-and-drop does not work properly. The teachers questions if the system does not need a break. "I do" he says. Before leaving the computer, he comes back to the welcome page and he is very upset when he observes that the course he just created does not appear under the tab "my courses". "I hope it is not lost". He sadly concludes "I must have forgotten to save it".

Lost. When he comes back, he takes the whole process from scratch: he recreates the course "evolutionair voordeel" and looks more closely at the tabs ("*why does "Grapple rules" contain as many rules as "all rules*"). The teacher looks for the "G-start" and creates it. He is happy that the newly created rules logically appears in "rules in use". He fetches the "G-prerequisite" rule under the other tab (all rules) and re-do the prerequisite relationship between "evolutionair voordeel" and "fobieen". He saves. He sees with satisfaction that a gray link is automatically created between the G-start rule and the prerequisite rule.

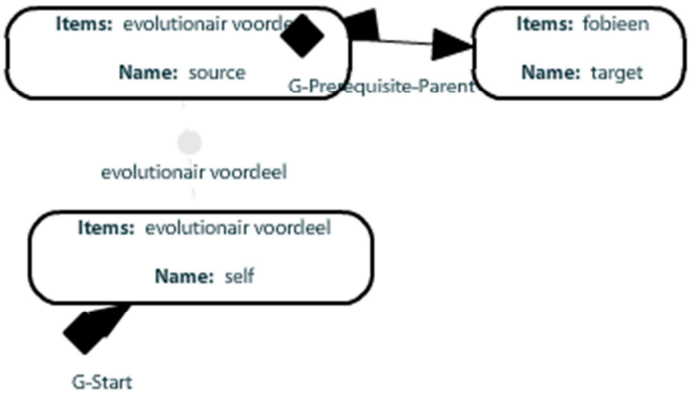


Fig. 8. A nice visual cue highlighting the relationship between two concepts

He now comes back to its idea to see this from the student's viewpoint: "*in my view, I have created a basic course. The student is presented with a concept as a start which is a prerequisite for the second concept*".

He sees that the course seems to be lost as it does not appear in "my courses". He nevertheless comes back to his domain ("*the things I did have presumably be inserted in the domain*") and tries to deploy. In vain.

Conclusion of Phase 6. The teacher leaves the trial, in a mood between irritation and laugh. "*I must conclude that I was unable to create a basic adaptive rule bearing on two concepts and that I could not see anything from the student's perspective. The step of the creation of the domain model is not easy but feasible. I still do not have any idea of what I am supposed to do or achieve afterwards. I guess I am partly responsible but I also finds that the tool could be improved and that such a concept-based approach is not self-speaking*".

1.1.5.2.6 Phase 6 – "Yes, the url of my course!"

After investigation by the Grapple team, it appears that the course could not deploy for three reasons:

- The domain model contained a colon in a node.
- The domain model contained one accent in a node.
- One socket was missing in the adaptive rules created by the teacher.

Error messages. The teacher regrets that the message errors regarding (1) and (2) are not clearer and that nothing allows a quick identification of the "rotten" links. As for (3), the teacher confesses his mistake but regrets the lack of clear error message and the use of "jargon" words like "sockets" that have nothing to do with educative practice and vocabulary. After this interruption, the teacher is unable to get back the faulty adaptive rules. He bypasses the difficulty by recreating "a course". He prefers to keep it to the basics with a "start" and a single "prerequisite-parent" relationship. The button "deploy" is active. He clicks on it and gets the following pop-up that he firstly qualifies as an "error message" because nothing distinguishes it from the previous problem flags and because no text says that he must go to this url.

Fig. 8. A not crystal-clear message

After an explanation by the Grapple team, he makes a copy/paste of the address in his browser. He arrives in a "grapple single sign-on". He enters the credentials he has used so far for the gat but the authentication fails. He registers and gets the credentials.

When the teacher enters the course, he is simultaneously happy and surprised. He is happy because he can see "*real content*" of his course obtained via a Grapple process. He is surprised for two reasons: a) there is no visible reference to Grapple in the interface. The download of the content from Box.net puts Box.net at the forefront. b) When he clicks on "login" or "view full site", it is the login or the site of Box.net which is displayed.

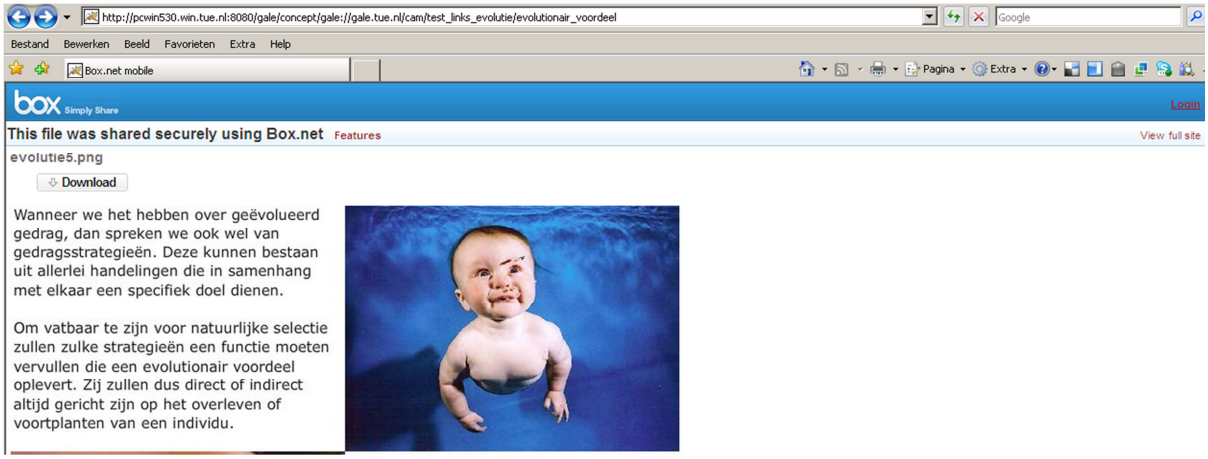


Fig. 9. The initial decision of the teacher to upload the course resources on an external website has unexpected consequences at the end of the process

The teacher wonders where he can go now. He admits that this page matches the "start" rule that he created. But how to go further? He had in mind that after the reading of this page, he could access to the page "fobieen" as an example of what is explained in this first page (evolutionair voordeel).

He believed that the whole course would be displayed, no regard to the number of adaptive rules created.

Conclusion of phase 6. The teacher ends up this testing session with a mitigated feeling. On the one hand, he got what he was looking for: the student's view. On the other hand, he feels stuck in this view. He guesses that he must have missed some adaptive rules that would allow him to access to the second page of content. On the whole, he realizes that different things happened, sometimes not smoothly, but happened anyway but he cannot get the whole picture of what was intended to through this long and sometimes cumbersome process. And this concerns only one very basic content and rule.

1.1.6 Key findings

In terms of their generalizability, diary studies may be of limited value: they generate, rather than test, hypotheses. As a final output of this study, we formulate now 5 hypotheses, as inferred from the data analysis. It is up to further investigation, conducted either with the same method applied on a larger sample or with other instruments addressing specific issues, to establish the value of these hypothesis and to evaluate whether they may have widespread application or remain idiosyncratic.

1.1.6.1 Hypothesis 1 – The ratio authoring time/added value of the adaptivity is not obvious to the practitioners

According to his self-report, the teacher spent about 23 hours authoring (we exclude the 3 hours of the initial Grapple training he attended to). He worked on an initial 4 hour course comprising 103 pages. He created a domain model of 51 concepts. He populated 10 out of them with resources. The final output regarding adaptivity is the creation of two rules relating 3 concepts. The teacher himself questions the efficiency. Though it should be clarified whether all the steps he used and the mistakes he did are not idiosyncratic, the Grapple tool seems to be quite time-consuming for him, at least in a first hand-on process.

Should this hypothesis be confirmed, it raises serious difficulties regarding a realistic chance of use in the classroom. Adaptive authoring tools must also be efficient of teacher's time. Grapple must not only be perceived as efficient for practitioners, it must also measure up with germane systems. The problem here is that the comparison is not easy to establish. The most satisfying yardsticks that we found in terms of efficiency's ratios come from Ainsworth (S. E. Ainsworth & Fleming, 2006). We give them as an indication.

> "In one study (S. Ainsworth, Grimshaw, & Underwood, 1999), authors took between 6 and 11 h (to author a 4 h course on "Understanding Shapes") – a ratio of around 3 h per hour of instruction. Ainsworth and Grimshaw (2002) found that a teacher took less than 25 h to create two environments (around 8 h of instruction). Navy authors began by requiring 10 h per chapter (around 6:1), which dropped to 6 h by the end of authoring (around 3:1)" (Ainsworth, p. 137)
>
> "Designers of intelligent tutoring systems hope that one day their systems will perform as well as expert human tutors, which, in itself, is very high goal. Bloom (1984) found that one-to-one tutoring by expert tutors, when compared to traditional whole class teaching, improves students learning by 2 sigma effect size. This was the only pedagogical technique which had such a marked effect. Currently, state-of-the-art in ITSs is around a 1 sigma effect with evaluations of ITSs revealing effect sizes of between .4 and 1.2 compared to classroom teaching (e.g., (Graesser, Person, & Harter, 2001; Koedinger, Anderson, Hadley, & Mark, 1997). However, the time and expertise needed to produce such clever systems has meant that such ITSs have not yet achieved widespread application in schools, colleges or workplaces – creating an ITS is estimated to take between 300 and 1000 hours to produce an hour of instructional material (e.g., Murry (1999)). (Ainsworth, p. 137)

1.1.6.2 Hypothesis 2 – Not only the tool but its underlying educational philosophy and authoring approach have incidence on the perceived efficiency

Beyond his frequent frustrations with the tool, the diary contained also questions and doubts about the whole pedagogical approach conveyed by Grapple. For instance, the mere assumptions that a domain can be represented by a hierarchy of concepts, a scaffolding of levels of knowledge and the determination of subsequent learning needs is sometimes questioned by the practitioner, at least for the ill-structured domain of his course. The teacher has some remarks about the integration of regular knowledge and competencies tests in such an framework. The teacher also wonders how Grapple, beyond the yes/no answers regarding the knowledge of a specific concept, is capable of dealing with various levels of proficiency of a concept or of a group of concepts. But it must be said that his initiation to the Grapple tool did not go far enough to help him to make up his mind regarding these issues. However, regardless what the view of the teacher would be in this case, the questions, and possibly doubts, of the teacher seem legitimate with regard to authors like Matan & Aviram (2005) who note that research in adaptive systems has still not yielded a scientifically corroborated set of methodologies to support personal learning and is flawed at an upper level by the lack of validated personalization theories. there are relatively few examples of adaptive educational systems in practical use. And since those personalized learning platforms based on adaptive philosophy remain so far small scale and mainly as experimental set-ups, this relative poverty leads to too few empirical investigations (Weibelzahl, 2005) which would demonstrate that most effective/efficient learning is achieved or facilitated thanks to such systems (Ronen, 2006).

The teacher took also time to make a mental shift from his familiar instructional design approach, favouring sequences of events in a sort story boarding, to the knowledge-based authoring that leans on a concept space.

1.1.6.3 Hypothesis 3 – Pre-shaped domain model or adaptive rules can enhance efficiency but may hurt responsibility

The time consuming aspects of the practitioner's work lies in the domain authoring, especially in its effort to break down his existing course into a concept map, and in the creation of the adaptive rules (though the time span of the experiment does not allow to check this aspects with clear figures). Ainsworth & al. (2003) show that when trainee teachers are presented with a previously authored course that they just had to individualize to their students, they only required 90 min to customize the 4 h course. However, when the teacher was asked whether he would accept to leave part of the authoring process (either concept mapping or adaptive rules creation), he was reluctant. The teacher claims that he wants to keep his responsibility in these critical aspects of the course. Though it must be further investigated, this position seems aligned with an observation by Bakker (2000):

> "Now, if a teacher, for example, is to accept devolution of part of responsibility for teaching to a machine, that individualises its instruction, then not only will the teacher have to manage the individualisation within a group (such as a class), but the teacher will also have to understand how that individualisation occurs in order to accept the devolution of responsibility. Software producers' manuals and demonstrations are unlikely to be sufficient in this respect; no doubt the system will have to be "transparent", in some sense of the term, for teachers".

Following these general hypotheses on efficiency, derived from the analysis of the teacher's account, we discuss hypotheses of a finer grain that relate to how could the efficiency of the Grapple tool, be enhanced.

1.1.6.4 Hypothesis 4 – To communicate about an adaptive system, it is reasonable to use teacher's views/vocabulary on the process rather than the name of technical components (CAM, GAT, sockets…)

The teacher decomposed his own work with the Grapple tool in on preparatory stage (The Mindmeister map as a preliminary step) followed by 6 distinct phases: The domain model, Adding resources to concepts, The long way to the student's view, Grappling with the adaptive rules, Trying out the adaptive rules, The url of my course. If some labels more or less overlap the different components of the Grapple tool, the teacher refers more spontaneously to his own pedagogical segmentations and actions with the components. The teacher seems also to consider that "his course" is already started in the domain model and wonders why he has to "create a course" later on.

1.1.6.5 Hypothesis 5 – The teacher needs tools to quickly test and control the consequences of his actions

The student's view, that would allow the teacher to check what he is doing from the student's perspective, is also a facility upon which the teacher puts frequent emphasis and which did not get much attention during the Grapple project. For the author, the only way to check the consequences of an authoring decision is to deploy the course and to go to the url provided by the system. In contrast, the teacher mentioned the smooth transition between the authoring environment and the student's view offered by Moodle.

1.1.6.6 Hypothesis 6 – Visual clues can be enhanced in the authoring process

The teacher noted that it would be helpful to see visually, in the domain model, which concepts have already received resources. In his preparatory phase, he unexpectedly did not use the Grapple tool as a starting point but an external mind-mapping service, claiming that he found there more visualization facilities (see his colored mind-map) and more flexibility to organize concepts. The teacher also wonders whether he could see visually, on the domain model, which concepts the student already masters. Request is also uttered about the possibility to show to the student the visual presentation of the domain he is working in, that is to open the domain model to the student and to enrich it with personal data, available to the student and the teacher.

1.1.6.7 Hypothesis 7 – Despite efforts put on usability and user-friendly interface, the Grapple tool remains possibly manageable only by a very modicum of teachers

The teacher recruited for this pilot had a favorable profile cumulating a teaching experience, an authoring experience and a knowledge of and a commitment to personalized learning issues. Nevertheless, was the authoring tool perceived as uneasy for a result that triggered perplexity. Indeed, it is usually impossible to obtain complex outputs without rather complex processes. And any new tool conveys its learning curve. However, a correct appraisal of the mitigated feeling coming out of the teacher's account, imposes to take into account that it originates in a person who seemed a priori able to benefit from the Grapple tool. Further investigation is needed to better identify the practitioners really able to make the most of the tool and to identify the current features of the tool that might be further enhanced to suit lower profiles. The success of

the adaptive learning approach partly depends on the extent to which the authoring tool is usable by its intended author population (classroom teachers, university lecturers, adult trainers),

1.1.6.8 Hypothesis 8 – The teacher sometimes prefers a less smart authoring environment

Interestingly, the teacher often opts for less powerful strategies. Indeed, he has read the different adaptive patterns offered in the help manual. However, he prefers starting modestly but quickly. He seems to prefer tangible results with familiar ways of doing, for instance the creation of a strict prerequisite structure, using fixed and not performance related succession of concepts (a strategy for which he could not find any support in the interface anyway). Though his reasons for doing this (tired of the tool, pedagogical rationale,) have not been disentangled, neither in the diary, nor in the final conversation, the teacher was all the way long more busy with the creation of a single teaching strategy that reflected his own preferred strategy rather than the Grapple designers' strategy as presented in the help tool. The value granted to the tool seemed very dependant of its ability to help materialize this well defined strategy (prerequisite). Need for a sense of control, priority to fulfilment of today's requirements (and not necessarily requirements for future needs) seemed here powerful influences that shaped the instructor's opinion about the Grapple tool.

1.1.6.9 Concluding hypothesis – There are discrepancies between generic versus contextualized claims about adaptive systems

From the semi-structured interviews survey conducted at the very beginning of the Grapple project (Harrigan, Kravčík, Steiner, & Wade, 2009) emerged the pretty high ratings of the practitioners for almost all features and dimensions of adaptivity, from the simplest to the most complex ones. The very limited end product (a single and basic adaptive path applied on a very limited part of the study material) obtained by the teacher in this pilot evaluation, and the time and effort he reports to achieve it, offers a striking contrast to this generic expression of interest. When confronted to a real exercise of adaptive rules creation, the observed teacher showed complex patterns and models of teaching and learning underpinning his work and playing a role in his interactions with the adaptive tool. Even simple actions required from the instructor to engage in complex inferences about what the tool can provide and how these facilities can serve his educational views. This pilot, focused on such a concrete implementation, suggests that there could be a breach between these uncontextualized claims and a discourse fed by a genuine confrontation with an adaptive tool. The teacher's diary not only describes the experiences of the participant but also highlights differences that may exist between the developer's and the practitioner's perspective.

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