

## Challenges to the implementation of CFT in initial and in-service teacher education

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In the present paper we propose a reflection around activities developed within Educational Technology (ET) practical classes, from the Licenciatura degree in Primary Teaching and the in-service Teacher Education Programme, both at the University of Aveiro, in which the students were expected to collaborate in the development of educational materials based on Cognitive Flexibility Theory (CFT), following a project work methodology. The tool used was DIDAKTOS (Didactic Instructional Design for the Acquisition of Knowledge and Transfer to Other Situations), a tool conceived and developed by researchers at the Department of Didactics and Educational Technology, University of Aveiro, and which was recently made available online (<http://didaktos.ua.pt>), and labelled DidaktosOnLine (DOL). This reflection derives from the analysis of difficulties reported by students in the discussion forum within the LMS used for these courses (Blackboard), and on reflections of the group of teachers involved. Results show that students revealed difficulties, especially in understanding the basic assumptions of CFT, for example the concept of case, the processes of knowledge deconstruction for the setting up of a conceptual matrix (required to be built collaboratively by the students), and the technical exploitation of DOL itself. Apart from the introduction, the present paper will include a brief reference to CFT and to its relevance for education. The contexts in which the work proposal took place will be described and, following the discussion of results, emerging conclusions will be put forward as well as the challenges faced and the proposed solutions for the next edition of these courses.

**Keywords** Cognitive Flexibility Theory, Teacher Education, Higher Education, online materials development, collaborative work

### 1. Introduction

Following the construction of a platform for the development of teachers communities of practice under the auspices of the Project “Digital Cities”, and taking advantage of this tool for the improvement of the teacher training courses offered at the University of Aveiro, the decision was made to use DOL in the normal teaching and learning activities of the ET courses offered at this higher education institution.

Based on the software DIDAKTOS (Didactic Instructional Design for the Acquisition of Knowledge and Transfer to Other Situations) [1], which finds its inspiration in CFT [2], DOL was created so as to allow for its distributed use by wider communities.

CFT is a theory of knowledge construction, learning and instruction that aims at bridging the gap between initial “surface” apprehension of knowledge and the attainment of expertise. This gap, described as the stage of advanced knowledge acquisition, is best tackled by means of case-based instruction from diverse conceptual perspectives, and finds its materialisation in cognitive flexibility hypertexts, of which DOL is an example.

In teacher education in Portugal, several studies based on CFT have already been developed [3-5]. Of these, the study by Pedro [4], which compared experienced and non-experienced teachers’ capabilities in developing didactic materials based on CFT principles, found that experienced teachers perform better and at higher levels of didactic decision than their counterparts. Although this finding might be naturally expected, we decided to follow a similar research path, this time comparing two groups of students doing the same course, but with differing backgrounds.

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## 2. Context of the study

Following a project work methodology in which students were required to collaborate in the development of educational materials based on CFT, two groups of students from teacher education degrees were opportunistically selected.

One group was doing a “normal” *Licenciatura* degree, under a pre-service teacher education programme; the other, composed of teachers who do not have a teaching qualification, following an in-service teacher education programme. The pre-service group was more homogeneous, both in terms of age and goal – to become Primary Education Teachers; the in-service group, on the other hand, had students from various backgrounds (engineering, arts, maths, business, etc.) and covered a wide age spectrum.

The project schedule was different for both groups: the pre-service group (45 students divided into two classes) worked 5 hours of ET per week, of which 4 were dedicated to practical lessons, for the last two months of the semester, under a b-learning regime. The in-service group (86 students divided into 4 classes) followed a schedule of 2 hours per week on the same subject, all of them of a theory-practical nature, throughout the whole semester, also under the same regime.

After a first contact with CFT in classes (lectures by the teachers) and readings on the subject, students were required to discuss it in the forums specially developed in Blackboard for that purpose. They were then introduced to the platform DOL and started developing their projects, discussing them collaboratively in Blackboard, with the supervision of their teachers. In the case of the pre-service group, a decision was made to structure their global project *a priori*. A knowledge domain was elected – energetic resources - (non) renewable –, based on Education for Sustainable Development [6], and the energetic resources distributed among the various sub-groups. Each sub-group would have to contribute with their part of the project, cooperatively, for the global class project. As to the in-service group, total freedom was given to the sub-groups for the development of their projects.

## 3. Method

A qualitative methodology of an exploratory nature was adopted, with some contributions typical of tracer studies, grounded on the content analysis of answers to a questionnaire, posts placed by the students in the online forums, and teachers’ reflections about the course.

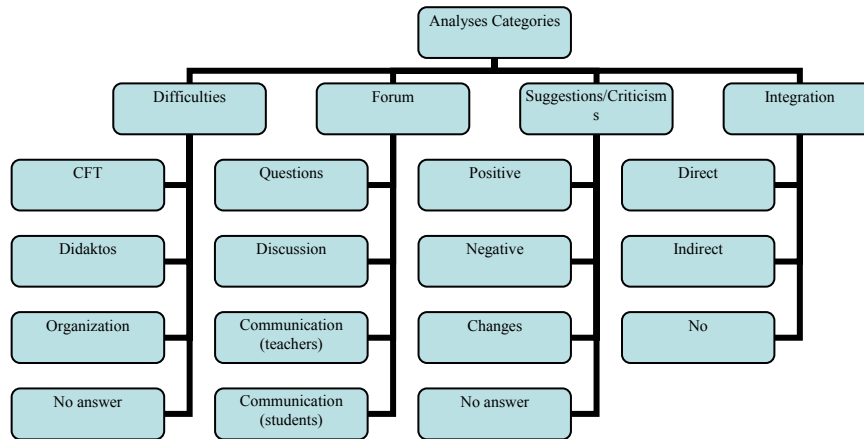
The objective of the questionnaire in two similar versions was to identify the students’ perceptions as to the difficulties they felt while attending the course on ET as regards the development of educational materials based on CFT principles.

In the case of initial teacher education, the questionnaire included 5 questions: difficulties associated with understanding the theory (lectures and documents made available to the students); transfer of the theory to the conception of materials; practical/technical aspects of the implementation of materials in DOL; positive aspects of the course; suggestions and constructive criticisms for its betterment.

For the in-service teacher education group, an extra question was added, addressing transfer of acquired knowledge/competences to teaching practice. Content analysis was done with QSR N6 [7], following grounded theory principles, as explained below.

As referred above, the present paper analyses the discussion forums made available in Blackboard and the questionnaires with open-ended questions submitted to the students.

Four major categories were taken into consideration: 1) Difficulties, 2) Forum, 3) Suggestions/Criticisms, and 4) Integration, as presented in Fig. 1.



**Fig. 1** Analysis categories

In the category “Difficulties” we gathered the participants’ opinion about the difficulties they found in terms of curricular and methodological organisation of the course, group-work, their relationship with teachers, with CFT and its technical application in DOL. In the analyses of the forums we also took into account possible difficulties that might be inferred from the posts. For this purpose we marked the posts as Questions, Reflections or mere process interactions of students and teachers. We also analysed whether the questions in the forums focussed on the way the course worked, DOL or CFT. The sub-categories of analysis under the category Discussion about CFT consisted of the analysis of whether the posts were mere collages of the “Definition” of the theory, a “Recovery” of colleagues’ posts on the topic or if they were more profound, containing contextualised comments on CFT. Concerning the category “Suggestions/criticism”, data was classified in 4 sub-categories: positive, negative, changes (suggestions about aspects to be changed related with the organization of the course and about DOL), and no answer. As to the integration of the worked carried out in actual teachers’ practices, the analysis took into account direct and indirect integration and no integration. All categories were analysed from the point of view of the comparison between the initial education and in-service education groups. Forums were also analysed from the perspective of their occurrence in time: beginning, middle or end of the semester.

## 4. Outcomes and Discussion

### 4.1 General difficulties

Table 1 shows the number of forum posts or questionnaire answers that express difficulties with course organization, CFT, DOL, and no answer/absence of difficulties.

**Table 1** Crossing course participants with difficulties

Participants	CFT	DOL	Organization	No answer
pre-service	41	13	16	18
in-service	21	16	5	5

The main difficulty concerns CFT understanding for both initial and in-service participants. These difficulties are expressed in the following statements: “Some documents were difficult to understand as to the theory”, “As far as I’m concerned it is a very complex theory”, “At present, if anyone asks me what CFT is, I don’t know the answer.” (*pre-service*); “The theory is extensive and a bit complex”; “I think its full

*comprehension can only be achieved with practice.*” (*in-service*). In the pre-service group, 42 out of 45 students had more difficulties with CFT than the in-service group (21 out of 82). The main CFT difficulty in the pre-service group seems to be its application to practice. This result confirms Pedro’s [4] conclusions and could be related to the time spent on the presentation of the theory, which was less than the time spent in the in-service course, but also to the lack of experience that those students had in the preparation of teaching materials.

#### 4.2 Forum analyses

**Table 2** Crossing course participants with Forum

Participants	Questions	Discussion	Students Communication	Teachers Communication
pre-service	5	38	4	1
in-service	13	1	32	0

Table 2 shows the numbers of forum posts distributed by the four sub-categories presented above. There was a special forum aimed at the reflections about CFT in the support site created for the students. This fact may explain the 38 posts from this group in the reflections category as compared to only one by the in-service group. Almost all (28) of these “discussions” are reproductions of CFT definitions. There were few contextualizations and real reflections about CFT. Considering that b-learning delivery of the course was more effective in the in-service group, it is easy to understand that routine communication between students is more present for those participants. Students’ questions were analysed regarding Course management, DOL and CFT. The in-service group posted more questions than the pre-service group. As it happened with difficulties with CFT and its application in DOL, questions at the end of the semester were mainly related to the use of DOL and the organisation of the course. In general, the large number of posts placed at the end of the semester may be due to the fact that the pre-service group began the module on CFT later in the semester. This can also be explained by the fact that the pre-service group’s participation in the forums was part of their assessment. The most visible difficulties posted in the forums occurred also at the end of the semester and were related to technical difficulties with DOL.

#### 4.3 Participants suggestions and criticisms

**Table 3** Course participants’ suggestions and criticism

Participants	Positive	Negative	Changes	No answer
pre-service	21	7	21	8
in-service	16	2	15	1

Table 3 shows the suggestions and criticisms written mainly in the questionnaires and are distributed by four categories. Although most of the criticisms are positive, there is a similar number of suggestions for change in the dynamics of the course: **Positive:** “*First of all, the fact that Prof. X is always available to help us is very good, because every time we went to him he would explain and help (so did the others). I think the most difficult part were the forums, forum 3 was difficult, but there was help, and although everything was complicated, the teacher would explain what we wanted.*” (*pre-service*); **Suggestions for change:** “*Perfect coordination between the teachers is necessary so that all explanations go in the same direction, for confusion not to arise. The way the forums are being used should be reviewed. I think that not everybody understood how these work.*” (*pre-service*). The pre-service group suggests more time dedicated to the discussion of CFT and explanations based on examples, although they were actually made available. In fact, one of the difficulties associated with the comprehension of CFT is the problem of the theory concepts/jargon that get confused with the more mundane semantics attached to them. That

is the case of such concepts like *knowledge domain*, *case*, *mini-case*, and especially *theme*, and even with examples, students also tend to find it difficult to grasp the concept of *deconstruction of knowledge*.

#### 4.4 In-service teachers skills integration

**Table 4** In-service participant's competences integration in teaching practice

Participants	Directly	Indirectly	No integration
In-service	3	4	4

We asked the in-service group whether acquired knowledge/competences were transferred to their actual practice. Table 4 shows their answers about integration of acquired competences or skills in their teaching. No in-service group member stated he or she was using DOL; 3 state they are using CFT principles in their teaching practice, but not necessarily in DOL; 4 others state that these skills are being used indirectly. Competences they admit using directly are illustrated by statements like: "*I acquired greater openness towards creating contents for LMS dedicated to collaborative work*"; "*I intend to lead students to use DOL, making more room for discovery on their part*"; "*I'm considering the possibility of applying acquired knowledge and use DOL in other situations throughout my teaching career.*" In fact, after the course finished, several requests for use of DOL were e-mailed to the authors, and such activity in DOL can already be witnessed, as at present our in-service ex-students are developing various projects.

### 5. Commentaries and further developments

Challenges to the implementation of CFT in initial and in-service teacher education seem to stem from the background and experience of the students, favouring those who already possess practical knowledge of the profession, especially when transferring CFT principles into practice, although the problem of fully understanding the theory persists for both groups. Results show that the in-service group is more pro-active and committed to discussion of the theory and its application, showing higher levels of interaction between its members. Future implementations of the ET course under the same format will have to pay special attention to CFT jargon and associated concepts, offering strategies that may overcome these comprehension problems, and also the provision of a variety of good commented examples of the application of CFT, rendering it clearer for the students. A set of guidelines and a glossary are also instruments under construction, along with an array of FAQ for the benefit of all using DOL.

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