Educational Technology Expertise Center
Open University of the Netherlands

Research fellow project proposal

This project falls in the following research topic(s):

- **Design**
  - Competence analysis / domain modeling
  - Learning tasks & learner support

- **Delivery**
  - Composing instructional messages
  - Computer-mediated communication

- **Diagnosis**
  - Performance-based assessment
  - Quality control & assurance

1. **Project chair**
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   - Function: Educational technologist
   - Department: Educational Technology Expertise Center
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2. **Project name**
   - English: Tools for identification, representation and validation of competencies in higher education
   - Dutch: Gereedschappen voor het bepalen, representeren en valideren van competenties in het hoger onderwijs

3. **Place in organization**
   - Design Theme of the research program of the Educational Technology Expertise Center.

4. **Synopsis of the research problem**
   - **English**
     In competence based learning, the design of the curriculum and of the assessment will be based on an identified set of competencies. The three main research questions in this respect are:
     1. How does one identify and validate different competencies for a profession or professional field?
     2. How does one describe and represent these competencies so that they can be used as a guide for curriculum design, a series of learning tasks and the necessary assessment procedures?
     3. What tools can be used to best support these activities?

   - **Dutch**
     In competentiegericht leren vormen de competenties de basis voor het ontwikkelen van een curriculum. In dit onderzoek staan de drie volgende vragen centraal:
     1. Hoe kan men bepalen welke competenties de kern vormen van een beroep of een deskundigheid en hoe kan men deze (verzameling van) competenties valideren?
     2. Op welke wijze moet men deze competenties formulieren en representeren zodat ze gebruikt kunnen worden bij het ontwikkelen van curricula, onderwijsenheden en toetsingprocedures?
     3. Met welke gereedschappen kunnen deze activiteiten ondersteund worden?
5 Research team

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<tr>
<td>a Project chair</td>
<td>Dr. R. Martens</td>
<td>Supervisor / ICO staff member Otec</td>
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<tr>
<td>b Project-team</td>
<td>Drs. A. Stoof</td>
<td>AIO researcher Otec</td>
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<td>To be determined</td>
<td>Others Otec / other</td>
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<td>c Other team members</td>
<td>To be determined</td>
<td>Technical programmer Otec</td>
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<tr>
<td>d Ph.D. supervisor</td>
<td>Prof. dr. J. van Merriënboer</td>
<td>Head of research department Otec</td>
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<tr>
<td>e Consultants</td>
<td>Dr. W. Verreck; Dr. K. Schlusmans;</td>
<td>domain experts Otec / University</td>
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<td></td>
<td>Prof. dr. M. Valcke</td>
<td>Gent</td>
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6 Length of the project

| Begin date:         | July 1, 1999 |
| End date:           | June 30, 2003 |
| Total length:       | 48 months    |

7 Intended output

a Publications and conference presentations
- Four articles in ICO accepted journals
- An article about competencies: definitions and characteristics, methods for classifications, representations for and identification of competencies
- An article about on the different methods used by institutes for higher education for identifying, validating and representing competencies
- An article about the results of the first experimental study
- An article about (a series of) tool(s) for identifying, validating and updating competencies
- Three presentations at international congresses (e.g., AERA, AACE, ICLS, EARLI)
- A minimum of two presentations at national congresses (e.g., ORD)
- Ph.D. thesis

b Instruments and procedures
- A electronic practitioner’s guide for identifying, validating and updating competencies.

8 Further elaboration

a Further elaboration of the problem and aims of the research project
A starting point for the Otec research program is that the development of competencies is, or at least should be, a central issue in higher post-secondary education. Where behavioral objectives, knowledge, skills and attitudes have been the key factors in curriculum design for several decades, competencies and competence standards are now becoming the main focus. As will be shown there is both a formal and a functional contradiction in the fact that many institutes define the concept competence as the starting point for rethinking their education while the concept itself is often a loose and poorly defined term.

Competencies: From a loose and poorly defined term to an operational definition
Competencies are conceptualized in different ways. In the Otec research program they are defined as the abilities that enable learners to recognize new problems in their domain of study and - future - work as well as the abilities to solve these problems. Competencies refer to the ability to operate in ill-defined and ever-changing environments, to deal with non-routine and abstract work processes, to handle decisions and responsibilities, to work in groups, to understand dynamic systems, and to operate within expanding geographical and time horizons. In other words, competencies are built upon the combination of complex cognitive skills (encompassing problem solving, qualitative reasoning, and higher-order skills such as “self-regulation” and “learning-to-learn”), highly integrated knowledge structures (e.g., mental models), interpersonal skills and social abilities, and attitudes and values (e.g., the will to believe in taken responsibilities). In addition, competencies assume the ability to flexibly coordinate these different aspects of competent behavior. Acquired competencies enable learners to apply complex cognitive skills in a variety of - not yet learnt - situations (“transfer of learning”) and over an unlimited time span (“lifelong learning”).
Others (see e.g., Bos, 1998, Verreck & Schlusmans, 1998, a) describe competencies as clusters of knowledge, skills and attitudes displayed in the context of a carefully chosen set of realistic occupational tasks which are of an appropriate level of generality. This emphasis on specific occupational tasks touches on the pending question whether competencies are always related to a profession or a professional field or whether competencies can be perceived in a broader sense as representing proficiency in a domain or subject matter area. All in all there seems to be quite some confusion, also depending from the context (e.g., more professionally or more educationally aimed) one is using the concept (e.g., Kessels, 1999; Mulder, 1998; Thijssen, 1998). Translation problems and linguistic issues make the job of a clear definition even more complex (see Kessels).

In practice, looking at institutes such as the Open University of the Netherlands (OUNL), there is an almost complete lack of professional, valid and reliable tools which have been defined and developed and upon which the definition, use and ordering of competencies for educational purposes can be based. Most developers use an intuitive way to design competence based education. The OUNL is itself caught up in this contradiction in that it is developing a powerful electronic learning environment (ELO: Otec, 1998), in which competence based education plays a crucial role, but it does not have the tools to develop the competencies that it must use. The research project described here will be linked to this development where it is of practical relevance.

In order to be able to use competencies as the foundation for curriculum design, it is essential to resolve the confusion about precisely what a competency is (cf. Bos, 1998). This research project will look into different conceptualizations of competencies and select or modify a definition which is most useful as a guide for curriculum design, development and assessment procedures. The project will have to make the concept operational in a scientific way and suitable for educational purposes.

Criteria for the identification, description and representation of competencies

If the curriculum and assessment of students in higher education is to be based on an identified set of competencies, it is essential to ensure that these competencies are valid and useful and describe the key characteristics that training and learning should entail. Part of the research project is to determine a set of criteria which can be used when making decisions on methods and procedures for identifying, describing and representing competencies. This means that the set of competencies must be described and represented such that they can be used by curriculum designers, represented in such a way that they can be used to communicate with students and professional field, are ‘linkable’ to underlying knowledge, skills and attitudes, are assessable, et cetera.

The identification and validation of competencies and competence standards

The next issue in this research project is ‘How to identify the right competencies? Which methods, instruments and procedures can and should be used?’ E.g., What are the differences between highly competent employees and their less competent colleagues? What are the (inter)relationships between competencies (hierarchical, heterarchical, orthogonal, …) and can they be ranked? In other words, can competencies be acquired in isolation from each other? What research methods lend themselves to defining competencies (survey research, direct observation, Delphi methods, cf. Parry, 1996, Jonassen, 1989)? Until recently most methods and instruments have been derived from the field of human resource development and in-company training. Institutes of higher education however have a unique position, so it is important to take this into account when identifying competencies for educational purposes. Of importance are curriculum descriptions, often with emphasis on competencies that have been developed in the context of Dutch higher vocational education (e.g., Procesmanagement lerarenopleidingen, 1998)

Describing competencies

As competencies will be used as a guide for curriculum design, development and assessment, it is important to establish in which way competencies need be described (e.g., an active verb, performance indicators, description of contexts, tasks, …). It is also important to establish the
relationship between the competency as an integrated concept and the underlying knowledge, skills and attitudes.

In this part of the research it is important to relate the theories about competencies with the theory about behavioral objectives (e.g., De Block, 1975; Bloom, 1970)

Representations of competencies - competence maps
It is probably not enough to just draw up a list of competencies for a specific domain or profession, but it is important to represent the totality of competencies in such a way that the relations and hierarchy between the different competencies is represented. This form of representation could be called a 'competence map'. The research project should look into ways of representing competencies and decide which is the best way to represent the competencies in clear relations and hierarchies. In this part of the research project it is important to look into the development of classifications and taxonomies of competencies and into representations of them such as lists, maps, tables (see e.g., Dijkstra, Krammer, & van Merriënboer, 1991).

Organizational issues
If the assumption is true that competencies are always related to specific 'professional' domains (the biologist) and not to traditional 'scientific' domains (biology), then part of this research must focus on specific organizational issues concerned with their identification. Who is / should be responsible for identifying competencies in higher education? What is the role of professional organizations in this respect? What is the role of lecturers? How does one make sure that the identified set of competencies is valid and up-to-date within the domain or profession? Is there a difference between institutes of higher professional education and universities?

Tools and guidelines for curriculum designers
The final aim of this research project is to develop a series of tools with guidelines, procedures and instruments for identifying, defining, validating, updating and representing competencies for a specific domain or profession in higher post-secondary education. These competencies have to be defined in such a way that they can be used as the foundation for the curriculum, a set of learning tasks, relevant knowledge, skills and attitudes and an assessment procedure.

The tools will be constructed and tested with emphasis on validity (do we really get proper representation of the relevant competencies in a certain content domain) and reliability (if other content domain experts were to use the instrument or if the same developers re-use the tools do they get about the same results)

In this research the following issues will be addressed:

- What are competencies? What are the main characteristics / components of competence?
- Which criteria are used when assessing methods and procedures for identifying, describing and representing competencies?
- How does one identify in a valid and reliable way the different competencies for a specific domain or a specific profession? Using the criteria mentioned above, what are the best ways for identifying competencies?
- What different representations and classifications of competencies and their interrelations can be used? What are the main characteristics and functions of these representations? Which representation is best with regard to the specified criteria?
- What tools can be developed to support the above mentioned issues and how do these tools perform? Do they improve validity and reliability?

Scientific importance of the research, including the importance for the Open University of the Netherlands and the place of the research in the Otec Research Program

Competence based learning is the major educational philosophy of the new educational strategy of the Open University of the Netherlands and is also widely used in the whole system of higher professional education in the Netherlands. If the whole curriculum and the assessment procedures within the curriculum is to be based on an identified set of competencies, it is of the utmost importance to establish well founded procedures, guidelines and instruments to help professionals to identify, describe and validate these competencies.
c  Design & Methods
Activities
  • definitions of competencies and competence based learning,
  • the description and representation of objectives and taxonomies in relation to competencies and classification of competencies
  • identifying criteria for identifying, describing and representing competencies in higher education
  • Survey of literature on methods for identifying competencies (cf. Jonassen, Hannum & Tessmer, 1989; Parry, 1996; Verreck & Schlusmans, 1998,a) e.g., Functional analysis, critical incident techniques, critical path analysis, et cetera.
  • Construction and refinement of a questionnaire on validity and reliability concerning procedures and methods used for identifying, validating and representing competencies. This questionnaire can be based on a questionnaire developed for this purpose by Bos & Martens (1998).
  • Analysis of procedures and methods (good practice) in different (educational) settings and organizations. Desk research, interviews and questionnaires for professionals in higher vocational training institutes, HR-managers in in-company training, representatives of professional organizations. Participant observation of working committees busy identifying competencies for different professions (field study). This study must result in a list of ‘critical variables’ or success-failure factors. These factors will be sought in aspects of systematic approaches, tools or procedures used for standardization and reliability/validity. This phase of the project will be more orienting and aiming upon drawing up an inventory, then a profound or experimental research. On the first place, it must support the construction of the framework and the development of a set of guidelines in the next phases.
  • Development of a theoretical framework for describing and representing competencies.
  • Development of a set of guidelines, procedures and instruments for identifying and validating competencies based on the literature and the analysis of good practice.
  • Research into existing tools that support identifying, validating and representing competencies in different (educational) settings and organizations. Tools are electronic glossaries with relevant terms and definitions and tools to support competence mapping. Examples of such tools are general purpose concept mapping tools like INSPIRATION-5 (1997) and SEMNET and dedicated tools such as Mercator (Valcke & Martens, 1997). Of interest are also worked out examples and step by step guidance. In general it will be attempted to use as much as possible existing tools.
  • Development of electronic tools to support identifying, validating and representing competencies in different (educational) settings and organizations. In this project not a lot of effort for constructing and programming of tools is foreseen. ‘Windows Help’ will be used to present examples, guidelines, et cetera to support developers, in combination with existing tools such as INSPIRATION-5.
  • Pilot study with these tools.
  • Two experimental studies: In most fields in higher professional education working committees are busy identifying competencies for different professions. Two professional fields (working committees) will be selected as case studies for this research. The case studies will have slightly different focuses. The first case study emphasizes the usability of the tools and the second case study emphasizes the product outcomes and how other developers (such as
programmers) can use the developed competence maps. Both experiments will use the electronic learning environment (ELO) at the OUNL. Developing teams will operate in this context and tools will have to fit - if possible - in ELO. In these two experiments the tools are tested and evaluated. Comparisons with the results from the earlier data collection within the ‘good practice’ setting will be made.

- The theoretical framework and the set of guidelines and instrument will be revised based on the results of the case studies.

![Diagram of phases in AIO project](image)

**Figure 1: Phases in AIO project**

The phases in the project are displayed in Figure 1. The design of the research is depicted by the dotted lines. The data gathered in the field test will be compared to the data collected in the two case studies. To guarantee a sound comparison, first valid and reliable instruments to measure the dependent variables are to be constructed. They are related to four categories of dependent variables (the effects that are expected from the use of tools), namely:

1. Validity and reliability of the competence maps (they can be measured by printed questions about e.g., expected reproducibility of the results, see Bos & Martens, 1998).
2. Richness of concept maps (e.g., types and number of relations between concepts, detailed information about concepts, number of competencies, quality of annotations, obviousness of structure, et cetera).
3. Usability for others (such as programmers or other developers)
Data will be collected by means of limited log files, electronic diaries, printed questionnaires, interviews, et cetera. These measurement instruments may not interfere with the actual competency development process.

The research project will begin with literature study, followed by desk research, interviews and participant observation (the field study) to help to define competencies and develop a framework for operationalizing them in curricula. This will be followed by two empirical studies. In these two case studies the same techniques will be used.

Case study 1 and 2
In the first case study at least 15 developers (if necessary in different teams) will construct competence-based education using the tools previously described and tested in the pilot study. Comparisons of process- and product variables (see above) will be made with the data collected in the field study (control group) (e.g., comparing the results of the questionnaires filled in by the experimental group and the control group).

In the second case study this is repeated with more emphasis on the usability of the outcomes. A team of developers will have to transform the competence maps into education for ‘third generation distance education’ (if possibly with the use of an ICT tool such as ELO). Since the Open Universiteit Nederland is currently reforming its education in the direction of ‘third generation distance education’ with the emphasis on competency based education, it can be expected that many courses/curricula will become available as possible research contexts. To date courses are being developed in this direction in the law domain and statistics for the social sciences.

Analysis
Besides techniques for qualitative data analysis, (multivariate) analysis of variance will be used to establish the influence of the variables and conditions.

d Literature
Beroeps- en Opleidingsprofiel. Intern document. Open Universiteit Nederland, Onderwijstechnologisch Expertisecentrum
Phase 1: Survey of literature on competencies and competence based learning, combined with introduction work placement at the Otec

Duration: 6 months
Deliverables:
- An article in an ICO-journal about definitions and characteristics of competencies

Phase 2: Ways of identifying competencies: desk-research and on-site research (interviews, questionnaires). Descriptions, representations and classifications of competencies: survey of literature + construction of theoretical framework

Duration: 7.5 months
Deliverables:
- An article about different methods for the identification and representation of competencies

Phase 3: Construction and selection of tools to support the development and delivery of competence based education, including a pilot study.

Duration: 7.5 months
Deliverable:
• Set of tools, guidelines to support the delivery of competence based education

Phase 4: Experimental study 1
Duration: 7.5 months
Deliverable:
• Recommendations for improvement of the tools
• An article about the result of the first experimental study

Phase 5: Revising (use of) tools
Duration: 3 months
Deliverable:
• Revised set of tools

Phase 6: experimental study 2
Duration: 7.5 months
Deliverables:
• Recommendations for improvement of the tools
• An article on the functions and effects of the tools used to support the delivery of competence based education

Phase 7: Writing/compiling Ph.D.
Duration: 9 months
Deliverable:
• Ph.D. thesis

The milestones (quarter/year) in the research are:
• Start (7/99)
• Evaluation (6/00)
• Article 1 (12/99)
• Article 2 (07/00)
• Article 3 (11/01)
• Article 4 (10/02)
• International presentation 1 (7 or 8/00)
• International presentation 2 (7 or 8/01)
• International presentation 3 (7 or 8/02)
• National presentation 1 (7/00)
• National presentation 2 (7/01)
• Thesis finished (6/03)
• Thesis defense (7/03)

Planning

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