The role of needs assessments in developing competence-based education in Mozambican higher education

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Abstract

Valid and reliable assessment of learning depends, amongst other things, on the precise definition of the outcomes and the expected results, as well as on the comprehensive description of performance criteria. In a competence-based approach assessment implies certifying the 'proof of competence' by the student. Competence is seen here in a holistic sense, as the totality of (core) competencies required to perform as a competent professional.

Competencies signify the link between professional practice and personal intentions and are either innate or acquired and developed during an educational intervention. Therefore, the formulation of competencies is an essential step in creating a competence-based learning environment. Competencies can be defined after an analysis of the profession.

This article describes a needs assessment aimed at characterising a profession in the form of key occupational tasks or roles and translating this professional profile into a graduate profile, including the core competencies that are the focus of the educational intervention. The design and development of a competence-based curriculum at the newly founded Faculty of Education at the Eduardo Mondlane University (UEM) in Maputo, Mozambique, will be used as an example.

Introduction

Two of the nine 'Principles for Practice for Assessing Student Learning', formulated by the American Association for Higher Education state: "Assessment works best when the programs it seeks to improve have clear, explicitly stated purposes" and "Assessment requires attention to outcomes but also and equally to the experiences that lead to those outcomes" (Astin, Banta, Cross, El-Khawas, *et al.*, 1996). These principles signify the importance of an alignment (Biggs, 1996) between assessment, learning outcomes and the learning environment. The need to clearly express learning outcomes and expected results is especially apparent in outcomes-based or competence-based education where the curriculum is based on what a participant of an educational programme should be able to do – what proof of competence should be demonstrated – at the end of the educational intervention. (McDaniel, Felder, Gordon, *et al.,* 2000).

Competence-based education and training is based on the acquisition and development of certain competencies. As will be explained below, competencies should not be seen in a narrow behaviourist way. Competencies are conceptualised as personal capabilities and form the link between professional practice and personal intention. They involve the interplay between knowledge, skill and attitude attributes and the meta-cognitive capacity to apply them at the right time when required. Competence is the totality of (core) competencies required to perform as a competent professional.

The point of departure of a competence-based curriculum is the professional practice, characterised by key occupational tasks that professionals are expected to be able to perform and the related competencies. From there the curriculum is designed 'downwards', starting with the intended learning outcomes in the form of competency statements, followed by the development of assessment methods (how are students to provide 'proof of competence'?) and resulting in the end in learning environments (how are students to acquire and develop the expected competencies?). Content knowledge is formulated as a function of the required competencies. This means that the formulation of competencies is an essential step in creating a competence-based learning environment and its related assessment procedures. Because "the determination of learning outcomes should be based on educators' careful and broad analysis of what a competent graduate of the program should be able to do" (Battersby, 2002), a needs assessment has an indispensable role in finding out what the world of work requires from graduates and how this can be translated into domain-specific and generic competencies. The research reported here addresses the question of what should be the competencies of the graduates of the newly founded Faculty of Education at the Eduardo Mondlane University, Mozambique. The UEM decided in 1998 to re-establish the Faculty of Education. The new Faculty started its activities in August 2001 with (post-graduate) programmes in Curriculum and Instruction Development, Adult Education, and Science and Mathematics Education (later on other programmes will follow). During the preparatory activities of the Faculty of Education the aims of its curriculum were described as the education and training of academic professionals who are able to perform confidently and expertly in an often rapidly changing job environment.

This article will focus on two masters programmes: Curriculum and Instruction Development, and Science and Mathematics Education.

A model of competence-based education

Competence-based education originates in the outcomes/performance-based teacher education programmes in the late 1960s (Hall & Jones, 1976; Hyland, 1995). A little later competence-based training and education appeared prominently in the UK, Australia and New Zealand. In response to the criticism on the behaviourist (Velde, 1997; Bates, 1995) and atomistic (Collins, 1991; Hyland, 1994; Kerka, 1998) character of the competence-based approach Hager (1993) and Gonczi (1994) developed a holistic conception of competence. Hager (1996) defined a competency as a complex combination of attributes (knowledge, attitudes, and skills) that underpins some aspect of occupational performance. The difference between the terms 'competence' and 'competency' is that 'competence' is taken as the whole of competencies needed to perform in a job as a 'competent' professional. Competencies form sub-sets of competence.

The approach by Hager formed the basis of a model of competence, competencies, tasks and performances that was developed for use in the newly established Faculty of Education at the Eduardo Mondlane University (UEM) in Maputo, Mozambique. This model is defined as the capability to choose and apply the attributes (complex set of knowledge, skills and attitudes) that are needed for the realisation of a certain task. In most cases more than one competency is needed to realise a task and personal characteristics (such as motivation and self-confidence) also play a role. The model developed for the Faculty of Education is presented in Figure 1 and can be summarised as follows (taken from Kouwenhoven, 2001):

- **Competence** is the capability to perform 'up to standard' the set of key occupational tasks that characterise a profession. A **competent** professional shows a satisfactory (or superior) performance. A profession is described in a **professional profile** that, in addition to the key occupational tasks, could also describe the profession and its position in the 'field of professions', the developments in the profession in the context of the society and the clients that the profession serves and how the quality of service is monitored.
- **Core competency** is defined as the ability to 'mobilise' the appropriate competencies in order to realise a key occupational task at a satisfactory or superior level. In other words, core competencies are 'built' out of a number of constituting domain-specific and generic competencies. Core competencies to be acquired and developed during the educational intervention together with the required levels of competence of the graduates are described in a **graduate profile**.
- **Competencies** can be *domain-specific*, pointing to capabilities within one specific content domain related to the profession. Another group of competencies is called '*generic'*, because they are capabilities that are needed in all content domains and are utilised for 'far transfer' (Everwijn & Palm, 1993) in which the professionals have learnt how to use the acquired knowledge and skills in new, atypical situations.

The acquisition and development of competencies, underpinning knowledge, skills and attitudes and a description of the required levels are given in the curriculum profile. The curriculum profile is thus the 'blueprint' for a competence-based learning environment.

The importance of a needs assessment in curriculum development

A needs assessment can be carried out for a number of reasons and in many different contexts. In the case of the Faculty of Education at UEM the context of the needs assessment was the process of design and development of the curriculum for the various programmes in the Faculty of Education. More specifically, it played an important role in the front-end analysis that preceded the formulation of the first design proposals and subsequent development activities. Kaufman (1997) and Witkin (1984) mention the importance of a needs assessment in educational planning and so do Moseley and Heany (1994), mentioning the "...importance of needs assessment as the first step of successful institutional planning and as a key preliminary step for long range planning" (63).

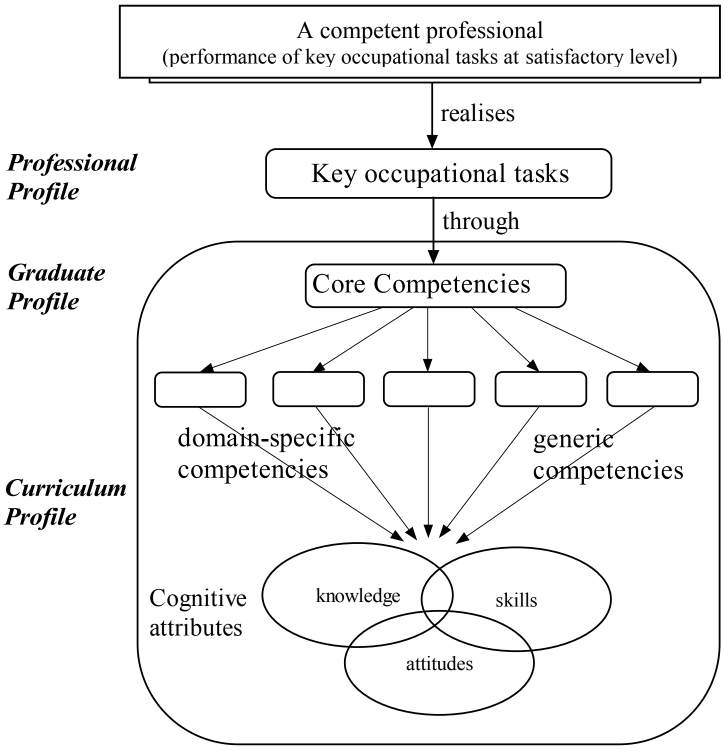

Figure 1: The relation between competence, core competencies and constituting competencies

In line with McKillip (1987) who outlines, amongst other things, the following purposes for a needs assessment: advocacy (in funding requests), description for understanding or academic purposes, planning for decision making about programme planning, the leading questions for this needs assessment were:

- Are the options chosen for the educational programmes in the new faculty legitimised by the professional communities?
- What professional profiles can be described for these two programmes?
- What generic competencies should be developed in the educational programmes?
- What contributions can the professional communities give to methodological and logistical aspects of the curriculum for the two programmes?

This article focuses on the second and third question. These questions correspond to the 'analytic view' on needs assessments that Stufflebeam (1985) describes as a direction that leads to predicted improvement, given sufficient information about the current status. In the case of the Faculty of Education of UEM one should rather speak about a 'hypothesised improvement' than Stufflebeam's 'predicted improvement', because it was hypothesised that a particular type of educational intervention would lead to an improvement.

The needs assessment for the educational programmes of the Faculty of Education reflects various views in the sense of Stufflebeam. It reflects the democratic view as far as it solicits the opinion from stakeholders on the desirability of four educational programmes in the Faculty of Education. It is analytic as far as it tries to establish directions for the curriculum of the programmes based on information on professional profiles and the related attributes or competencies. It is diagnostic because it aims to find evidence that an absence of the educational programmes could impede the development of the educational sector and that their presence would lead to an improvement of the quality of education in Mozambique. The discrepancy view is more related to issues of improvement of existing programmes often in terms of 'performance' and therefore less relevant here.

In a broader definition Young (1994), referring to Witkin (1984), describes a needs assessment as a "…preliminary examination of a situation to determine the potential for an educational program as a solution to a problem or a response to a need in the labour market or community", which covers the three 'Stufflebeam' views mentioned above.

Onstenk and Moerkamp (1991) characterise a professional profile by tasks and by qualifications. The definition of the tasks includes the 'organisation of the labour/profession and the developments in the profession'. The professional profile can be formulated based on an occupational analysis. Such an analysis leads always to a description of the 'tasks' of a job or occupation, but some authors also include competencies in the description (Bayly & Merrit, 1995; Brown, 1999; Lankard, 1996).

Onstenk and Moerkamp (1991) introduce an 'education and training profile', in addition to the professional profile, that describes the aims and structure of education and training programmes. This profile is the blueprint for the development of a curriculum, or the curriculum profile.

The curriculum development (or revision) process following the various stages from professional practice to curricula, is characterised by Brandsma (1993) as 'The Royal Track'. It is a methodology for the identification of changes in the qualification demands in a profession and the translation of these into curriculum change. The Royal Track is a rather linear design process in which firstly, a professional profile is defined with tasks and roles based on the information from the profession. This is then translated into a description of an education or training programme in terms of outcomes and general structure and leads then to the development of the curriculum of the programme. Brandsma (1993) is rather critical about the use of professional profiles to define a curriculum. He states that there is no one-to-one relation between a professional profile and a curriculum. In many professions this relation is rather 'diffuse', however in some, like health, law, accountancy and education it can be more straightforward. In the case of the Faculty of Education at UEM the description of a 'graduate profile' has been introduced as an intermediate between professional profile and curriculum, being similar to the 'education and training profile' in the Royal Track and characterised by core competencies and competency standards. The time-consuming character of The Royal Track is also problematic as the developments on the labour market are accelerating in speed. This means that curriculum change is always lagging behind the developments in society. However, shorter, more rapid methods can be applied that might provide adequate and timely responses to changes in society and professions (see Drok, 1998). Brandsma's argument that often much emphasis is placed upon professional, domain-specific competencies and that generic, transferable competencies are often left out is also noticed by other authors, leading to more attention for integrated approaches in occupational analysis (Baily & Merritt, 1995; Brown, 1998; Lankard, 1996), for example, the Occupational Competency Analysis Profiles, designed by the Ohio State University (1995).

Most of the present methods used in occupational analysis aim to describe tasks and 'underpinning' competencies. The International Labour Organisation, ILO (1993) defines occupational analysis as the "Action that consists of identifying, by observation and study, the activities and technical factors that make up an occupation. This process includes the description of those tasks that must be fulfilled, as well as the knowledge and qualifications required to perform with efficacy and success a determined occupation".

As is the case in qualitative research a multi-pronged approach (triangulation of data) should be preferred (see Scheerens *et al.,* 1993). Klink *et al.* (1999) give a useful overview of methods that are used to define a professional profile.

The Mozambican case

As outlined above, the design and development of a competence-based curriculum for the Faculty of Education started with the elaboration of professional profiles based on needs assessments for the various educational programmes. The following sections describe the methods used and the results obtained from the needs assessment for the postgraduate programmes in Science and Mathematics Education as well as in Curriculum and Instruction Development.

Methods

In order to answer questions on professional profile, including (generic) competencies, for both programmes, it was decided that a list of key occupational tasks and a list of generic competencies should be included in the needs assessment and that respondents should be asked to rate the importance of the items for their profession.

The instruments (Januário, 2000; Mandlate, 2000) consisted of highly structured interviews with a number of key-informants. Structuring the interviews was done in order to achieve a high degree of comparability amongst the four educational programmes and to facilitate the analysis of interviews within a programme.

The lists with (key) occupational tasks and generic competencies were put together after a review of the literature (for example: Richey, Spannaus & Spector, 1999, and Competencies and Skills for instructional designers, n.d.), a comparison with similar education programmes elsewhere (for example: Alverno College Faculty, 1994; Nolan, 1998) and consultation of Dutch experts in the area of Science and Mathematics Education from the Free University Amsterdam and Curriculum and Instructional Development from the University of Twente.

A deliberate choice was made to limit the lists of occupational tasks and generic competencies (named '*attributes*' in the instruments) to about 25 items. It was assumed that this number would be sufficient to describe the professions and the generic attributes needed to perform well in the professions (see Hager, 1993). On the other hand a limited length would also avoid a lapse of attention during the interviews and a reduction in the reliability of the answers.

A sample of items from the list of occupational tasks and attributes is given in Figure 2.

Figure 2: Examples of items from the needs assessment instrument

Key occupational tasks in the area of curriculum and instruction development (examples)

The graduate does not have to develop all tasks mentioned. What is important is to indicate what tasks a graduate should be able to perform in the professional field you are working in.

Key occupational tasks	**Classification**				**N/A**	**Comments**
	Not important	Of some importance	Important	Very important		
1. Develop a curriculum	1	2	3	4		
2. Develop a training programme (seminar or workshop)	1	2	3	4		
3. Design and develop instructional materials	1	2	3	4		

Attributes necessary for a professional in the area of science and mathematics education (examples)

Attributes	**Classification**				**N/A**	**Comments**
The capacity to:	Not important	Of some importance	Important	Very important		
1. Use a variety of educational strategies in teaching with small and large groups	1	2	3	4		
2. Guide group work	1	2	3	4		
3. Analyse critically a curriculum of a certain discipline and a certain level	1	2	3	4		

Note: In the first example the total list contained 23 items (Mandlate, 2000). The second example is from a list of 24 attributes or competencies (Januário, 2000). The complete lists can be found in the annex.

As can be seen from the example the answers on the items were pre-coded and space was provided for comments by the respondents, if needed.

Only the instrument for the programme in Science and Mathematics Education could be piloted with about ten Mathematics and Science educators attending a conference in Maputo, the capital of Mozambique. The outcomes of the pilot led to editorial improvements in both instruments.

The choice was made to use a purposeful sample of informants, which was motivated by the (limited) number of key-informants in both occupational areas in Mozambique and the time available for this type of survey. 'Stratified sampling' (Patton, 1987) was used and key informants were sought from five categories:

- Public sector, including formal basic and intermediary education, public services, etc.
- Private sector, non-commercial (NGOs, UN, etc.)
- Private sector, commercial (trade and industry)
- Higher education sub-sector, offering education programmes
- Others, for example, parastatals such as the Mozambican Radio and Television Broadcasting and the bank of Mozambique

Then the most 'information-rich' (Patton, 1987) informants were selected and approached for interviewing. Selection criteria were the position in the organisation (directors might be most useful in providing information), professional experience (teachers might be most useful for information about the teaching profession) and historical knowledge about education in Mozambique (this concerned especially some high-ranking civil servants in the Ministry of Education).

Purposeful sampling or judgement sampling (an example of non-probability sampling) may not reflect the larger population (Charles, 1998). Although it is believed that the sample is representative of the specific population, the purposeful sample remains "subject to a risk of bias of unknown magnitude" (Kalton, 1983). This again calls for triangulation to reduce bias and increase validity (Denzin & Lincoln, 2000). Triangulation of the results was planned to take place through a presentation and discussion of the results with the stakeholders (the group commissioning the study, the co-ordinators of the Educational Programmes, further academic staff of the Faculty, partners from overseas and key informants) during a seminar.

In the months July to September, 2000, interviewees were contacted. After they had agreed to participate in the needs assessment, an introductory letter was sent to them with more information on the establishment of the Faculty of Education and on its educational programmes. The sections on key occupational tasks and attributes were also added to the letter, to allow the interviewees ample reflection on the various items before answering. Visits were made to a number of provinces in order to interview informants from outside Maputo. In some cases there was no opportunity to interview the informants personally and the interview protocol was left with them and collected at a later stage. In summary, 30 informants came from Maputo (capital of Mozambique) and 10 from the provinces; 23 were interviewed for the Science and Mathematics Education Programme and 17 for the programme in Curriculum and Instructional Development.

For the analysis of the data two SPSS files were prepared for the two programmes. All the 'closed' questions and open questions that allowed coding into categories were included. As is shown in the results section, mostly descriptive statistical methods were used to answer the general questions. Cluster analysis was used to discover certain 'dimensions' or groups of (key) occupational tasks and attributes. Reliability-coefficients (alpha) were calculated for each group. Because the small number of cases made firm conclusions impossible, a factor-analysis was also done, followed by calculation of the reliability-coefficients of factors. The two files were then merged into one single file to allow a comparison between the results for the two programmes.

Results

Some general data

Most of the interviewees had management positions in their organisation. There were 18 directors, 3 'pedagogical' directors and 12 heads of department or co-ordinators, while the remaining 7 interviewees were mainly teachers. The gender of the informants was mainly male: 26 as against 14 female, with relatively more male interviewees in the Science and Mathematics Education area (16/23) than in Curriculum and Instructional Development (10/17). Most of the interviewees, 27 of the total of 40, were in the age group of 35- 45.

In terms of formal education the large majority of the interviewees had an academic qualification: 19 Licenciatura, 13 Master's degree and 4 a PhD. Three informants had a

'Bachelors' degree and one finished formal education at secondary school level. It should be noted that a Bachelors degree in the Mozambican/Portuguese system is comparable to a 'diploma' status in the Anglo-Saxon world, while the Licenciatura degree is comparable to a Bachelors Honours degree.

On key occupational tasks

The lists of key tasks and the related competencies were different for both educational programmes and will, therefore, be discussed separately. After that the results for the (generic) competencies will be discussed.

Key occupational tasks in Science and Mathematics Education

In the interview protocol for the Science and Mathematics Education programme a list with 28 key tasks was given of which the interviewees had to indicate the importance on a four-point scale (see Annex). Fifteen of the twenty-three respondents thought themselves capable of rating the importance of the key tasks, fourteen rated all tasks. Amongst the eight, who did not answer the section on occupational tasks, were four directors of educational institutions and two representatives of the National Institute for Education Development. This surprising finding may signify the influence of the colonial past and, even more, the strong hierarchical and bureaucratic socialist years, preventing educational professionals from taking a broad look at their profession and commenting on areas for which they do not have direct responsibility. Generally the respondents rated the tasks at a high level of importance (lowest mean value 2,7 and highest value 3.6 on a four-point scale where 1 indicated 'not important' and 4 'very important'). See the Annex for an overview of the rating of all tasks.

Hierarchical cluster analysis was applied to see whether it would be possible to group the tasks under certain 'dimensions'. Using, in the SPSS package, the method of 'Complete Linkage' coupled with the cosine measure of similarity, two major clusters could be distinguished:

- A group of tasks related to *teaching* Science and Mathematics. Two subgroups in this cluster related to production of teaching materials and to teacher training activities
- A group of tasks related to *design and development* activities. Subgroups could be characterised by curriculum development activities, planning and policy-making, and evaluation of curricula and educational systems. A somewhat 'outlying' group within this cluster contained management support and the teaching of content and didactics in pre- and in-service courses.

Average ratings for the six subgroups did not differ significantly. The ratings are given in Table 2.

Table 2: Average ratings of six subgroups of key occupational tasks for Science and Mathematics Education (N = 28)

Group	Sub-group	N	Mean	SD	Alpha
Teaching	Producing teaching materials	7	3.31	0.32	0.85
	Teacher training	6	3.32	0.18	0.74
Design and Development	Curriculum development	6	3.12	0.32	0.78
	Planning and policy making	3	3.23	0.24	0.70
	Evaluation of curricula and systems	3	3.23	0.26	0.57
	Other (management support, content teaching)	3	3.08	0.22	0.77

The use of hierarchical cluster analysis assumes interval data. The use of ordinal Likert scale items, however does not to seem "…to affect Type I and type II errors dramatically.." (Jacquard & Wan, 1996). These results were verified by subjecting the 28 variables to a factor analysis (principal components with varimax rotation) with 6 factors (cumulative percentage of variance: 76% of total), of which the following showed a considerable overlap with the cluster analysis:

- Producing teaching materials. Five of the seven tasks in the same group of the cluster analysis loaded on this factor. The reliability coefficient was 0.85.
- Other (management support, content teaching). The same tasks were found as in the cluster analysis.
- Curriculum development. Five of the six tasks in the same group of the cluster analysis loaded on this factor. The reliability coefficient was 0.76.

One may conclude that in the area of teaching science and mathematics the production of teaching materials is seen as an important key occupational task. Curriculum development may also be considered a key occupational task for science and mathematics educators. Both areas appeared in the curriculum document that forms the basis of the educational programmes in the Faculty (Faculdade de Educação, 2001). The curriculum document mentions three 'dimensions' for the professional domain of Science and Mathematics Education: Vision and Reflection, indicating key occupational tasks to be developed in the domain at macrolevel (ministries, directorates and national institutes) of the education system; Didactics; and Instructional Design.

Key occupational tasks in Curriculum and Instruction Development

A similar analysis was done for the area of Curriculum and Instructional Analysis. Here the list of (key) occupational tasks included 22 items. Fourteen of the seventeen respondents responded to the question to rate the importance of these tasks. The range of ratings was a little higher than in the case of Science and Mathematics Education (mean values from 2.6 to 3.7).

The cluster analysis with the same parameters as in the case of Science and Mathematics Education resulted in three clusters of more or less similar tasks. The first group could be characterised by curriculum design and development, with two subgroups: general activities such as design and development of education and training programmes, and more specific activities, such as design systems for student assessment. The second group deals with design and development of instruction and instructional materials, and the last group was about project management and tasks in the area of educational policy making.

The average ratings for the groups are given in Table 3.

Table 3: Average ratings of groups of key occupational tasks in the area of Curriculum and Instruction Development (N = 23)

Group	Sub-group	N	Mean	SD	Alpha
Curriculum design and development	General activities	5	3.53	0.26	0.40
	Specific activities	5	3.39	0.04	0.81
Planning of instruction and design and development materials		6	3.04	0.25	0.82
Project management		5	3.18	0.33	0.95

Two tasks were not included in these three groups: developing strategies for human resource development, and advising on and monitoring (from a policy perspective) the development of curriculum projects. Both tasks received relatively low ratings in terms of importance. An exploratory factor analysis of the 23 variables (principal components, eigenvalues greater than one) extracted four factors, one of which contained the tasks from the cluster 'Project management'(see Table 3), and a few tasks from the cluster 'general activities in Curriculum design and development. This factor was labelled 'Carrying out curriculum projects' and comprised 10 tasks from the total of 23, with a reliability coefficient of 0.94. The second factor comprised tasks from the cluster 'Design and development of instruction and materials' and a few tasks from the cluster 'Specific activities in curriculum development'. This factor was labelled 'Design and development of instruction and materials' and was composed of 6 tasks, with a reliability coefficient of 0.81. The remaining factors contained very few variables and differed with the two other groups identified in the cluster analysis. In view of the low reliability coefficient of the group 'general curriculum development activities', that was identified in the cluster analysis and taking into account the reliability coefficients of the two factors on which 16 of the 23 tasks had a high loading, the data point to occupational tasks of curriculum and instruction developers in the areas of 'carrying out curriculum projects' and 'design and development of instruction and materials'. In the final 'blueprint' for the programme in Curriculum and Instruction Development four areas are mentioned that are important for a professional in this field: Design and development of curricula, including materials; Applied research and evaluation; Dissemination and implementation; and Planning and management. Two of these areas (Design and development of curricula, and Planning and management) appear also as important groups of tasks in the needs assessment. The other two have been added, based on the input of curriculum and instruction development experts from overseas (co-operating universities in the Netherlands).

In general the ratings reveal a relatively low recognition of the importance of ICT in the case of the respondents in Curriculum and Instruction Development (the two lowest rated items dealt with ICT skills), while respondents in Science and Mathematics Education rated ICT higher. This might be explained by a supposedly higher technological literacy rate for the last group.

On (generic) competencies

The second part of the interviews concerned a question about the importance of domain-specific and generic competencies or 'attributes', necessary for professionals in the field of Science and Mathematics Education, respectively Curriculum and Instruction Development (see the Appendix for the full list). The importance of the attributes had to be rated on a four-point scale (1 = not important; 4 = very important).

For both programmes the lists contained competencies that were more related to the profession (domain-specific) and generic competencies. The average ratings for domain-specific attributes in the field of Science and Mathematics Education were high (range 3.00-3.86) whereas the results for Curriculum and Instructional Development were lower (range 2.57-.79). Table 4 contains a comparison of generic attributes that appeared in both instruments.

A cluster analysis did not result in meaningful outcomes; this was also the case when separate analyses were done for domain-specific and generic attributes. Therefore, the attributes are indicated separately and not in groups.

Table 4 : Mean rating scores for generic attributes

Attribute	Science&Maths (N = 14)		Curr&Instr. (N = 13)	
	Mean	**SD**	**Mean**	**SD**
Master mathematics at an acceptable level	3.79	0.43	3.14	0.66
Use the Portuguese language	3.64	0.63	3.86	0.36
Communicate	3.57	0.51	3.50	0.76
Resolve problems	3.43	0.51	3.46	0.66
Interact with others	3.29	0.61	3.43	0.51
Take decisions	3.21	0.98	3.69	0.48
Manage information	3.14	0.66	3.43	0.76
Use the English language	3.07	0.83	3.64	0.50
Be a competent leader	3.07	0.73	3.64	0.74
Use assessment and evaluation, when required (judge)	3.00	0.96	3.77	0.44
Manage projects	2.93	0.73	3.07	0.73

Respondents in both areas rate the use of Portuguese high, but differ on the use of English, whereas the respondents for the Curriculum and Instruction Development programme rate the use of English higher. This may be an indication of the relative isolationism of professionals in the field of Science and Mathematics Education, whereas Curriculum and Instruction developers already have a more regional/international view. Another difference is the rating of the competency to assess and evaluate that is rated much higher (although a significant difference could not be determined, due to the small number of cases) by respondents of Curriculum and Instruction Development. A number of related generic competencies (such as leadership and taking decisions) also score relatively high on the list of Curriculum and Instruction Development. The mastery of Mathematics is, as can be expected, rated very important (and the highest) in the case of Science and Mathematics instruction and much less in the case of Curriculum and Instruction Development. Respondents in both domains rate project management competencies lowest in the list of eleven common generic competencies. The low rating by respondents of Curriculum and Instruction Development for ICT-competencies is worrying in the light of global developments in ICT and the growing importance of ICT in education, particularly in distance education. This result illustrates that curriculum decisions should not only be based on information coming from a needs assessment, but that the vision of the experts in the new Faculty of Education is another important factor in this process.

A further analysis of the total set of data was done to find out whether there was a difference in the 'rating' of certain common tasks and attributes for the two educational programmes. The four rating categories were collapsed into two: 'important' or 'not important' and then a cross-tabulation and chi-squared procedure was applied per educational programme and per sector, in which the respondents were working. The only significant difference was found in the task 'Develop policies' for education on middle and long term'. Fifty per cent of the respondents for Science and Mathematics Education found this task important against 7% of the respondents for Curriculum and Instructional Development (Chi-squared: 6.3, significance: 0.012). Thus, although policy development (and project management) appears in Curriculum and Instructional Development as a distinguishable group of tasks, there is not much support for policy-related tasks. An analysis per sector of the results on the task 'writing policy documents for the education sector' showed that it received a rather low rating by representatives from the Government sector. Triangulation, for example through a discussion of the needs assessment results with government representatives, could clarify this issue.

Discussion and conclusion of the Mozambican case

The design and development of a curriculum for the Faculty of Education started with a needs assessment, as part of a 'front-end' analysis. It covered three areas, namely the need for educational programmes in a Faculty of Education at the UEM, the description of professional profiles that form the basis for graduate profiles and the organisation of the curriculum in the Faculty. It involved a 'purposeful' sample of informants with supposed knowledge about the professional aspects of Science and Mathematics Education or Curriculum and Instructional Development. The sample showed a high representation of the sectors Higher Education and Government and low numbers of informants from trade, industry and services. This may explain why, for example, in the Curriculum and Instructional Development area there was not much interest in Human Resource Development issues. The high number of informants from the capital city Maputo can be justified by the presence of many institutions in the education sector or with relations to this sector, implying a relatively high number of key informants.

Results of the cluster analysis of key occupational tasks suggest that a post-graduate programme in Science and Mathematics Education at the UEM should focus on the pedagogical-didactical competencies of a Science or Mathematics Educator and on competencies in the design and development of practical solutions to educational problems. In the case of Curriculum and Instructional Development the focus areas of the educational programme should be curriculum design and development, design and development of instruction and instructional materials, and project management, with lower ratings for the last two groups than for general and specific curriculum development activities. In both cases it is clear that the low number of respondents, although representing a purposeful sample, leads to caution in the interpretation of the results of cluster analysis and/or factor analysis. Again, verification of the results in a discussion with interviewees and a wider group of stakeholders could shed more light on the need to reject or confirm the results.

The method of using key tasks to allow a description of professional profiles can be characterised as a modified DACUM method. In the DACUM (Develop a Curriculum) approach, experts meet in a few intensive sessions to define together a professional profile (Norton, 1996; Brown, 1998). Bailey and Merritt (1995) report that the use of modified DACUM methods is a common practice. In their research they found out that nineteen out of twenty pilot-projects in various industries that aimed at developing 'skills standards' used modified DACUM methods. Some projects used DACUM to validate existing industry standards. Other projects started already with a list of tasks already obtained from various sources (as was the case in the needs assessment). Again others started with a clean sheet but used more experts, included workers and also used observations and surveys. In the case of this needs assessment highly structured interviews were used.

In most occupational analysis methods (key) tasks are analysed as well as the underlying competencies (Brown, 1998; ILO, 1993). In the needs assessment for the Faculty of Education programmes the informants were asked to rate certain competencies, presented as attributes necessary for professionals, but these competencies were not closely related to the tasks in the needs assessment instruments and concerned sets of domain-specific and generic competencies.

Personal communication with the interviewers revealed that many interviewees seemed to be not very knowledgeable about the concept of competencies or attributes. It seems preferable, in this case, to design the graduate profile with the 'in-house' expert knowledge, and then later to discuss this profile with stakeholders.

In conclusion, the process of design and development of the curriculum for the Faculty of Education at UEM has been based on the outcomes of the needs assessment, although the vision and expertise of local staff and counterparts from the Dutch co-operating universities also played a role. The additional input was especially necessary when, apparently, the respondents did not have a clear idea of recent developments in the professional area or could not oversee the whole area. The low rating of ICT is a good example, where respondents, because of their unfamiliarity with the increasingly important role of ICT in education did not see the value of competencies in this area, but where the local and overseas expertise led to inclusion of ICT issues in the curriculum of the post-graduate programmes in the Faculty of Education.

The needs assessment should serve, therefore, not only as a basis for a competence-based curriculum but also as a toll to legitimate additional inputs, based on expertise in the area. This makes the needs assessment a continuous process contributing to the formative evaluation and feedback during the development process.

Appendix

Results of the ratings of occupational tasks and competencies (attributes) for Science and Mathematics Education and Curriculum and Instruction Development

Rating of 28 key occupational tasks in Science and Mathematics Education

Key occupational task	Mean	SD	N
Develop in-service courses and learning materials	3.64	0.50	14
Develop experiments and laboratory guides which make use of day-to-day materials	3.64	0.63	14
Train students for work in resource-poor environments	3.57	0.87	14
Develop support teaching practice materials: teaching practice handbook, training for mentor teachers	3.50	0.65	14
Develop and produce a variety of educational resource materials, other than textbooks	3.47	0.64	15
Lecture content and educational courses in pre-service programmes	3.43	0.85	14
Analyse school results (exams, output, drop-out) and prepare feedback for the system	3.40	0.74	15
Translate educational problems into concrete proposals for improvement	3.36	0.75	14
Professional support to teachers and school (content, educational)	3.36	0.75	14
Train students to develop learning materials for schools	3.33	0.82	15
Develop practical examinations or problems based on real-life situations	3.29	0.73	14
Write teaching guides and textbooks for teachers	3.29	0.73	14
Write textbooks for pupils	3.29	0.93	14
Outline educational policies for the mid- and long term	3.21	0.58	14
Plan and budget development plans for science and mathematics education	3.21	0.98	14
Organise, plan, prepare, implement and evaluate teaching practice with attention for student teachers, mentor teachers and school heads	3.20	0.77	15
Teach science education learning theories, constructivism, teacher-led demonstrations	3.20	0.77	15
Organize and implement programmes for novice teachers	3.20	0.94	15
Planning, guiding and evaluating the process of school-based exams	3.20	0.94	15
Develop curricula for teacher education courses: content and methodology courses	3.14	0.77	14
Assessment and evaluation of students and courses	3.14	0.86	14
Lecture content and educational courses in in-service programmes	3.14	0.86	14
Analyse curricula of other educational systems for use and applicability in new situations	3.00	0.65	15
Assessment and evaluation of teachers in programmes	2.93	0.62	14
Plan, prepare, conduct and evaluate short and longer workshops	2.93	0.62	14
Management support to teachers, heads of department and schools	2.80	0.77	15
Collect and translate literature on teachers education and learning difficulties into specific learning materials	2.73	0.88	15
Translate science policy guidelines into implementable activities	2.71	0.46	14

Rating of 22 key occupational tasks in Curriculum and Instruction Development

Key occupational task	Mean	SD	N
Develop a training programme, including seminars and workshops	3.71	0.47	14
Evaluate a curriculum/programme/course/module/materials	3.64	0.50	14
Develop a curriculum	3.64	0.63	14
Conduct training programmes, seminars, workshops	3.57	0.51	14
Communicate orally and visually (including written communication)	3.43	0.76	14
Conduct a needs assessment	3.43	0.76	14
Develop systems for pedagogical management that serve to diagnose and guide/accompany students	3.43	0.65	14
Ensure efficient implementation of curriculum innovations	3.38	0.65	13
Develop educational materials	3.38	0.77	13
Plan and manage educational projects	3.36	0.75	14
Elaborate project proposals	3.36	0.93	14
Design, manage and analyse student assessment	3.36	0.93	14
Develop a virtual learning environment	3.36	0.93	14
Produce interactive programmes via radio, TV, Web, specific software or hardware	3.15	0.77	14
Design and monitor projects and budgets	3.15	0.86	14
Conduct applied research for curriculum	3.07	0.62	14
Select and adapt learning materials	3.07	0.83	14
Plan educational activities, like lessons or other didactical units	3.07	1.08	14
Plan human resources	2.93	1.00	14
Work as an advisor in a curriculum development project	2.93	1.00	14

Design strategies for human resource development	2.69	1.18	13
Elaborate documents on the educational policy of a certain sector	2.64	0.93	14
Design market strategies	2.62	0.96	13

Average ratings for 24 attributes in the field of Science and Mathematics Education (N=14)

Attributes	**Mean**	**SD**
The graduate should have the ability to:		
Master the subject content at an appropriate level	3.86	0.36
Master mathematics at an acceptable level	3.79	0.43
Write clear, attractive and accessible texts	3.71	0.47
Use the Portuguese language	3.64	0.63
Plan realistically teaching and learning processes	3.64	0.63
Develop exams, questions and problems at different cognitive levels	3.64	0.63
Communicate	3.57	0.51
Teach and lecture classes using a wide variety of delivering modes and instructional and educational strategies, including practical work in science	3.50	0.52
Analyse relationships with other subjects	3.43	0.52
Resolve problems	3.43	0.52
Prepare lesson outlines for a course/semester	3.43	0.65
Adapt and translate electronic (Internet) into appropriate learning materials	3.43	0.65
Utilise resources effectively	3.36	0.50
Interact with others	3.29	0.61
Analyse critically the curriculum for a particular subject at a particular level	3.29	0.61
Take decisions	3.21	0.97
Manage information	3.14	0.66
Make judgements about different assessment techniques without referring to prescribed routines or general teaching rules	3.14	0.66
Translate a school curriculum into a curriculum for teacher education	3.07	0.62
Lead	3.07	0.73
Use the English language	3.07	0.82
Organise and manage group work	3.00	0.88
Use assessment and evaluation, when required (judge)	3.00	0.96
Manage projects	2.93	0.73

Average ratings of 23 attributes in thefield of Curriculum and Instruction Development

Attributes	**N**	**Mean**	**SD**
The graduate should have the ability to:			
Use the Portuguese language	14	3.86	0.36
Make a situational analysis (understand the context of a curriculum or instruction)	14	3.79	0.43
Have an ethical professional approach	14	3.79	0.58
Use assessment and evaluation, when required (judge)	13	3.77	0.44
Take decisions	13	3.69	0.48
Use the English language	14	3.64	0.50
Know and use research methods	14	3.64	0.50
Lead	14	3.64	0.74
Promote the collaboration, partnership and good relations between the participants in a curriculum development project	14	3.57	0.65
Select and use a variety of techniques to define the sequence of content and methodology in curriculum or instruction	14	3.57	0.65
Analyse the characteristics of an emerging technology and its application in an instruction environment	14	3.50	0.65
Communicate	14	3.50	0.76
Resolve problems	13	3.46	0.66
Design methodological techniques	14	3.43	0.51
Interact with others	14	3.43	0.51
Select, modify and create a conceptual framework (model) appropriate for a certain project	14	3.43	0.76
Utilise basic techniques in ICT (e-mail discussion lists, virtual conferencing, etc.)	14	3.21	0.80
Master mathematics at an acceptable level	14	3.14	0.66
Make a cost-benefit analysis for certain options (how to modify, buy or develop materials)	14	3.14	0.66
Manage projects	14	3.07	0.73
Utilise ICT in professional tasks	14	3.00	0.78
Design web-based instruction	14	2.57	0.76

References

Alverno College Faculty. 1994. *Student assessment-as-learning at Alverno College (Third Edition)*. Milwaukee: Alverno College.

Analysis & Technology, Inc. (n.d.). *Competencies and skills for instructional designers*. [Online]. Available url: http://www.coed.usf.edu/inst_tech/resources/competen.html. Accessed April 10, 2002.

Astin, AW, Banta, TW, Cross, KP, El-Khawas, E, Ewell, PT, Hutchings, P. *et al*. 1996. *Nine principles for good practice for assessing student learning*. [Online]. Available url: http://www.aahe.org/principl.htm. Accessed September 9, 2002.

Bates, I. 1995. The competence movement: Conceptualising recent research. *Studies in Science Education*, **25**, 39-68.

Battersby, M. 2002. *So, what's a learning outcome anyway?* [Online]. Available url: http://www.c2t2.ca/page.asp?item_id=394. Accessed September 9, 2002.

Bayly, T & Merrit, D. 1995. *Occupational job analysis*. [Online]. Available url: http://ncrve.berkeley.edu/abstracts/MDS-777/Projects3.html. Accessed April 4, 2002.

Biggs, JB. 1996. Enhancing teaching through constructive alignment. *Higher Education,* **32**, 347-364.

Brandsma, TF. 1993. *Professional profile and curriculum development: The royal track as naïve traject?* Doctoral thesis. Enschede: Universiteit Twente. (Dutch)

Brown, BL. 1998. *Task analysis strategies and practices. ERIC clearinghouse adult, career and vocational education. Practical application brief.* [Online]. Available url: http://ericacve.org.docs/taskanal.htm. Accessed April 20, 2002.

Charles, CM. 1998. *Introduction to educational research (2nd Edition)*. White Plains, NY: Longmans Publishers.

Collins, M. 1991. *Adult education as vocation*. London: Routledge.

Denzin, N & Lincoln, Y. (eds). (2000). *Handbook of qualitative research* (2nd ed.). Thousand Oaks, CA: Sage.

Drok, J. 1998. A model for a project approach to curriculum reform. *Onderzoek van Onderwijs,* **27***,* 38-41. (Dutch)

Everwijn, S & Palm, H. 1993. Useable knowledge and skills. *Opleiding en Ontwikkeling,* **1993**(11), 13-19. (Dutch)

Faculdade de Educação. (2001). *Post-graduate programmes in science and mathematics education, curriculum and instruction development, adult education.* Maputo: Universidade Eduardo Mondlane.

Gonczi, A. (1994). *Developing a competent workforce*. Adelaide: National Centre for Vocational Education Research.

Hager, PJ. 1993. Conceptions of competence. [Online] Available url: http://www.ed.uiuc.edu/EPS/PES-Yearbook/93_docs/HAGER.htm. Accessed June 16, 2001.

Hager, P. 1996. *Conceptualising the key competencies*. Paper presented at the ERA-AARE Joint Conference, Singapore, 25-29 November.

Hall, GE & Jones, HL. 1976. *Competency-based education: A process for the improvement of education*. Englewood Cliffs, NJ: Prentice-Hall.

Hyland, T. 1994. Silk purses and sows' ears: NVQs, GNVQs and experiential learning. *Cambridge Journal of Education*, **24**(2), 233-243.

Hyland, T. 1995. Behaviourism and the meaning of competence. In Hodkinson, P & Isett, M. (eds). *The challenge of competence.* London: Cassell.

International Labour Organization. 1993. *The 40 most frequently asked questions about competence*. [Online]. Available url: http://www.ilo.org/public/english/region/ampro/cinterfor/temas/complab/xxxx/7.htm. Accessed September 2, 2002.

Januário, F. 2000. *Post-graduate programme in science and mathematics education. Report on the needs assessment.* Maputo: Universidade Eduardo Mondlane (Portuguese).

Kalton, G. 1983. *Introduction to survey sampling*. Newbury Park, CA: Sage

Kaufman, R.1997. Needs assessment basics. In Kaufman, R & Thiagarajan, S. (eds). *The guidebook for performance improvement: working with individuals and organizations.* London: Kogan Page, 143-157.

Kerka, S. 1998. *Myths and realities: Competency-based education and training*. Columbus, OH: ERIC clearinghouse on adult, career and vocational education. [Online. Available url: http://www.stw.ed.gov/products/1049/1049.htm. Accessed January 15, 2002.

Klink, M, van der Bos, E & Boon, J. 1999. *Looking for diversity: From competencies in the professional practice to curricula.* Paper presented at the Education Research days, 20 May, University of Nijmegen, the Netherlands. (Dutch)

Kouwenhoven, W. 2001. *Education for academic professionalism: reflection and research on the design and development of a competence-based curriculum for a new Faculty of Education*. Paper presented at the 9th Bolewsa International Research Symposion, Gaborone, 28 July – 2 August 2001.

Lankard, BA. 1996. *Job Training versus career development: what is VocEd's role? ERIC Digest.* Retrieved April 4, 2002 from http://ericacve.org/docs/dig171.htm

Mandlate, E. 2000. *Masters programme in Curriculum and Instructional Development. Needs assessment.* Maputo: Universidade Eduardo Mondlane.

McDaniel, EA, Felder, BD, Gordon, L, Hrutka, ME & Quinn, S. 2000. New faculty roles in learning outcomes education: The experiences of four models and institutions*. Innovative Higher Education,* **25**, 143-157.

Moerkamp, T & Onstenk, J. 1991. *From profession to schooling: Inventarisation of procedures for the development of professional and curriculum profiles*. Utrecht: RVE adviescentrum volwassenen educatie. (Dutch)

Moseley, L & Heaney, MJ. 1994. Needs assessment across disciplines. *Performance Improvement Quarterly,* **7**(1), 60-79.

Nolan, DJ. 1998. *Regents College: the early years*. Virginia Beach, VA: Donning Publishers.

Norton, RE. 1996. *DACUM Handbook*. Columbus (OH): Center on Education and Training for Employment, College of Education, Ohio State University.

Patton, MQ. 1987. *How to use qualitative methods in evaluation*. London: Sage Publications.

Richey, RC, Spannaus, TW & Spector, TM. 1999. *The revised IBSPTI instructional design competencies: Practical and theoretical implications*. Paper delivered at the 1999 Annual Convention of the Association for Educational Communication and Technology at Houston, Texas.

Scheeres, H, Gonczi, A, Hager, P & Morely-Warner, T. 1993. *The adult basic education profession and competence – promoting best practice.* Sydney: University of Technology.

Stufflebeam, LH, McCormick, CH, Brinkerhoff, RO & Nelson, CO. 1985. *Conducting educational needs assessment*. Dordrecht, the Netherlands: Kluwer Nijhoff Publishing.

Velde, C. 1997. *Crossing borders: An alternative conception of competence and implications of professional practice in the workplace*. Proceedings of the 27th Annual SCUTREA Conference. [Online] Available url: http://www.leeds.ac.uk/educol/documents/000000294.htm. Accessed January 23, 2001.

Vocational Instructional Materials Laboratory. (1995). *Job profiling guide: Results of the 1995 job profiling part of the Ohio vocational competency assessment package.* Columbus: Vocational Instructional Materials Lab, The Ohio State University.

Witkin, BR. 1984. *Assessing needs in educational and social programs*. San Francisco: Jossey-Bass.

Young, GL. 1995. *Needs assessment in program planning.* [Online]. Available url: http://www.senecac.on.ca/quarterly/CQ.html7HHH.o31.CQ.W94.Young.html. Accessed March 14, 1999.