Design and Implementation of Degree Programmes in Applied Geology

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Design and Implementation of Degree Programmes in Applied Geology

Digne Edmond Rwabuhungu (Editor)

Phase II

Design and Implementation of Degree Programmes in Applied Geology

Tuning Africa Project Phase II

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Content

Preface

The harmonisation of higher education in Africa is a multidimensional process that promotes the development of an integrated higher education space on the continent of Africa. The objective is to achieve collaboration across borders, sub-regionally and regionally, in curriculum development, educational standards and quality assurance, joint structural convergence, consistency of systems as well as compatibility, recognition and transferability of degrees to facilitate mobility. Harmonisation is necessary for achievement of the African Union vision of integration, peace and prosperity.

Tuning Africa was adopted as a possible instrument to advance the African Union's harmonisation agenda, in collaboration with the EU through the Joint Africa-EU Strategy. Implementing a second phase of Tuning was one of the commitments taken at the 2014 Africa-EU Summit in 2014 in Brussels, as a follow-up to the very successful pilot phase which took place between 2011 and 2013.

At the November 2017 Africa-EU Summit in Abidjan, Heads of State committed to deepening their collaboration and exchange in education, aiming at increasing the employability of young people bearing in mind that investing in youth and future generations in Africa is a prerequisite for building a sustainable future. In this context, further concrete initiatives in the field of higher education which aim to enhance relevance and the quality of education and training will be encouraged.

By contributing to the harmonisation of higher education in Africa, Tuning Africa is complementing Erasmus+, the Intra-Africa academic

mobility programme and the Nyerere scheme; thereby enhancing the mutual recognition of academic qualifications and facilitating exchanges and mobility of students and staff across the continent and with Europe. This is instrumental for acquiring key skills and competences that are important for employability, facilitating collaborative research addressing common challenges, and for ensuring relevant and quality education. The dialogue on credits and a common credit system for Africa is another major deliverable for Africa. All these initiatives are in line with the Continental Education Strategy for Africa as well as Africa's Agenda 2063 which calls for an education and skills revolution.

Tuning Africa has provided a platform for dialogue on quality assurance and the improvement of teaching, learning and assessment in higher education. Bringing together academia and employers, and importantly in this second phase, the active involvement of students, has been crucial. The success of Tuning Africa has been the involvement of a critical mass of universities and stakeholders, the ownership and commitment of all involved, as well as a transparent and credible leadership.

The AUC and EC are grateful to all the African and European experts involved in the production of this book, which is an outcome of the Joint Africa-EU Partnership Harmonisation and Tuning Africa 2 initiative.

African Union Commission and European Commission

Chapter 1

Introduction

Digne Edmond Rwabuhungu

The Tuning Africa Project, comprising 120 universities from 41 African countries, has continued to meet its obligations since its inception with respect to the harmonisation of higher education curricula for African universities. The context for curriculum reform and modernisation of Tuning Africa project Phase I (Teklemariam *et al.*, 2014) continued to the second phase of the project (Project number: EAC-2015-0138). The first General Meeting took place in Cairo (Egypt) from 12 to 14 October 2015. That was followed by four similar meetings: i.e. in Addis (Ethiopia) from 29 February to 2 March 2016; Accra (Ghana) from 17 to 19, October 2016; Johannesburg (South Africa) from 3 to 5 April 2017; and finally, in Brussels (Belgium) from 13 to 15 November 2017. The objectives of each forum, for each participating institution, were to meet the established benchmarks or indicators of progress towards implementation and commitment for the adoption of Tuning Methodology; to participate in the Tuning Africa II General Meetings; to apply Tuning Methodology in re-designing degree programmes in the eight designated Subject Area Groups, including **Applied Geology;** to allow student participation in different calls as part of the project "Student Voice in African Harmonisation Process in Higher Education"; as well as research proposals for "Tuning Africa Symposiums". Experts and/or specialists who participated in the development of the curriculum for the Subject Area of Applied Geology (Annex) explored novel methods for ensuring that the curriculum is outcome-oriented. That was achieved by generating relevant and workable lists of generic competences and subject-specific competences that meet international standards. The participants

who consistently gave their professional input were drawn from the following institutions and countries:

- Algelia, *Centre Universitaire de Tamanghasset.*
- Burkina Faso, *2IE-Institut Internationale d'Ingénierie de l'Eau et de l'Environnement*.
- Cameroon, *Université de Maroua*.
- Democratic Republic of Congo, *Université de Lubumbashi*.
- Ethiopia, *Adama Science and Technology University*.
- Ivory Coast, *Université des Sciences et Technologie de Côte d'Ivoire*.
- Kenya, *Jomo Kenyatta University of Agriculture and Technology*.
- Libya, *Sebha University*.
- Madagascar, *Université d'Antananarivo*.
- Mauritania, *Université des Sciences, Technologie et Medecine.*
- Nigeria, *University of Nigeria*.
- Rwanda, *University of Rwanda*.
- South Sudan, J*uba University*; and
- Tunisia, *Université de Tunis, Faculté des Sciences de Tunis.*

Development of Africa is certainly in need of harmonised competence-based higher education curricula that focus on the application of concepts of Earth Sciences and geological information. As stated by Tarbuck and Lutgens (2014), "the Earth Sciences is an interdisciplinary field of study which examines earth as a system composed of various interacting parts. It is well known that no specific definition of Applied Geology exists even if the fundamentals of geology is mostly considered as theoretical study while applied geology deals not only with the fundamental knowledge of earth sciences but also with the use of natural resources".

Applied Geology focuses on the application of basic geological knowledge for addressing environmental, engineering, and geo-hazard problems. It covers a variety of topics including geodynamics, sedimentology and stratigraphy, volcanology, engineering geology, environmental geology, hydrogeology, geo-hazard and mitigation, mineral resources, energy resources, medical geology, geo-archaeology, as well as applied geophysics and geodesy (Diyaning *et al.*, 2017). Harmonised curricula, if well-coordinated, will facilitate effective harnessing of natural resources of the continent such as oil, gas and groundwater. It will also guarantee that preventive and mitigation measures are instituted to mitigate geohazards while monitoring effects on the environment caused by exploitation of the natural resources.

This book is intended to highlight the achievements attained in Phase II with emphasis on workable generic competences determined in Phase I and subject-specific competences adopted for the intended curriculum in Applied Geology. Course units and time allocation that was deemed to be adequate were also provided accordingly.

The second chapter focuses on the definitions of Generic Competences in a thematic perspective. Chapter 3 introduces Subject-specific Competences for the curriculum in Applied Geology and the Tuning Methodology used, whereas the broad consultation with stakeholders and its main findings are presented in Chapter 4. The Meta-profile generated for Applied Geology is described in Chapter 5 with some examples of how it is linked to real degree profiles in Chapter 6. That was achieved through consultations and by using analysis of the results obtained with reference to the generic and subject-specific competences. Ultimately, the harmonisation exercise led to an effective review of the existing programmes and creation of new programmes in Applied Geology that are competence-based. Some examples are presented in Chapter 7, while student workload issues are discussed in Chapter 8. Chapter 9 contains concluding remarks and a summary of the Applied Geology SAG's activities.

Chapter 2

Initiatives and Curricula Addressed

Danwe Raidandi and Digne Edmond Rwabuhungu

2.1. Introduction

The Higher Education System in Africa has experienced multiple national, regional and continental initiatives such as the Nyerere mobility programme, the Higher Education Harmonisation programme, Quality assurance initiatives, and the Pan African University. Thus, institutional reforms have intensified in all African countries resulting in the Harmonisation of Higher Education and Quality Assurance Programme as one of the new transformative initiatives that unites national, regional, continental and international institutions.

The vibrant Tuning Africa Project is part of this partnership strategy between Africa and the European Union (EU). This project makes use of a methodology that has already been tested internationally. The methodology makes it easier to compare curricula systematically as well as to promote student mobility in Africa.

2.2. Generic Competences for Applied Geology

Identification and generation of Competences is one of the first steps that Tuning Africa addressed in the process of curriculum development. The Tuning project begun by focusing on the generic competences that graduates are expected to acquire regardless of their area of specialisation.

2.2.1. *Scope of Competences - a Tuning Approach*

Tuning is a broad concept and represents a dynamic combination of:

i. Knowledge and understanding at different levels.

ii. Skills and abilities.

iii. Attitudes and values.

Competences are used to define degree profiles and they are formed in various course units and assessed at different stages.

Some competences are subject area-related (specific to a field of study) while others are generic (common to any degree programme) in nature. Tuning approach intends to identify a profile of learning outcomes and competences both generic as well as specific (González and Yarosh, 2014).

Participants from the above mentioned universities who participated in the second phase of Tuning Africa Project under the Subject Area Group (SAG) of Applied Geology began their work by identifying; reviewing and validating the pan-African list of generic competences generated in the first phase of the project, and then formulated the subject-specific competences accordingly.

As stated by Michael Allaby (2008), Geology literally is the study (Greek logia) of the earth (Greek geo). Geology is the scientific study of the composition, structure, and history of the Earth. Recently, many branches of Geology have become established as disciplines in their own right (i.e. Geochemistry, Geomorphology, Geophysics, Mineralogy, etc.).

In fact, as a starting point, the concept "Applied Geology" was defined and adapted to the African context as:

> The application of geological knowledge, principles and techniques in order to solve problems in exploration and exploitation of Natural resources, Geotechnics, Environmental protection and Geohazards.

2.2.2. *Review/Validation of the Generic Competences*

After a critical examination of the 18 competences agreed during the Tuning Africa Project II forum in Cairo (Egypt), the three new SAGs (including Higher Education Management and Economics) accepted the generic competences and their definitions with minor changes including re-formulation of some of the competences (Teklemariam *et al.*, 2014). We can recall that Tuning Africa Project began at the end of 2011 and, one of its first tasks was to define Generic Competences for Africa. At that time each Subject Area Group (SAG) was asked to submit a list of the generic competences considered to be relevant from their perspective.

As a starting point for preparing this list, they were given the thirty-one generic competences identified in Europe http://www.unideusto.org/tuningeu/), the twenty-seven generic competences identified in Latin America http://tuning.unideusto.org/tuningal/), the thirty generic competences identified in Russia (http://www.tuningrussia.org) and a range of contributions from different participants in the project.

Onana *et al.* (2014) confirm that at the first General Project Meeting, in Yaoundé (Cameroon), in January 2012, the five Subject Area Groups (SAGs) working at that time discussed the proposal for setting the generic competences. The five groups presented a compilation of the generic competences in draft form, and the five coordinators agreed on a final list. On the last day of the meeting, participants decided in a plenary session to present a definitive list of eighteen generic competences and define the specifications.

Applied Geology SAG which started in Tuning Africa Phase II analysed each generic competence earlier defined.

Members of the group for Applied Geology then adopted the final generic competencies (Table 1).

Every generic competence can be applied in the Applied Geology context as shown in the next chapter.

Applied Geology SAG members discussed some elements which are directly related to the consultation process. Even if the group decided to organise a consultation process focused on Applied Geology subject-specific competences, it was agreed to adopt the cluster sampling system.

Table 1
Generic Competences

S/N	Generic Competences
1	Ability for conceptual thinking, analysis and synthesis
2	Professionalism, ethical values and commitment to UBUNTU*
3	Capacity for critical evaluation and self-awareness
4	Ability to translate knowledge into practice
5	Objective decision making and practical cost-effective problem solving
6	Capacity to use innovative and appropriate technologies
7	Ability to communicate effectively in official/national and local language
8	Ability to learn to learn and capacity for lifelong learning
9	Flexibility, adaptability and ability to anticipate and respond to new situations
10	Ability for creative and innovative thinking
11	Leadership, management and teamwork skills
12	Communication and interpersonal skills
13	Environmental and economic consciousness
14	Ability to work in an intra and intercultural and/or international context
15	Ability to work independently
16	Ability to evaluate, review and enhance quality
17	Self-confidence, entrepreneurial spirit and skills
18	Commitment to preserve African identity and cultural heritage.

* UBUNTU (respect for the well-being and dignity of fellow human beings).

In this system (Onana *et al.*, 2014), people surveyed were grouped by universities and respondents were not strictly independent from each other, with the result that such sampling could not, in all probabilities, be considered random.

At the same time, universities have a certain clustering effect at the level of each country.Citing Bryk and Raudenbusch (1992), Draper (1995), Goldstein (1992, 1995), Goldstein and Spielgelhalter (1996) and Onana *et al.* (2014) affirm that cluster designs are widely used

in research and do not represent a source. But it is also clear that cluster sampling can affect the error rate of sampling of the study of any calculation generated. However the sampling error increases depending on the differences in the questions measured between conglomerates.The design effect due to cluster sampling has to be calculated using an intra-class correlation. A high intra-class correlation indicates that differences among the conglomerates are high and, therefore, increases the sampling error in the research. It should be noted that a low interclass correlation in any question, i.e, close to zero, indicates that a simple random sample would have given similar results. All calculations and conclusions take into account the nature of data clusters, at university and at country level, using multi-level models. This model was considered to be the most suitable, because it takes into account the structure of data clustering. That is, it does not assume that the observations are independent as they are in a random sample. These models have been extensively used in educational research since the segmented structure is nearly always present. At the same time, multi-level models allow for the simultaneous appreciation of individual differences and conglomerates, giving suitable calculations of typical errors and making appropriate any deduction at an individual and conglomerate level (i.e. countries/universities). In this context, conglomerates are not seen as a fixed number of categories of an explanatory variable (i.e. the list of the universities selected as a fixed number of categories), but rather the selected conglomerate is considered as belonging to a totality of conglomerates. At the same time, it provides better calculations at an individual level for groups with a small number of observations.The participants decided to consult subjects according to these two variables:

- The degree of importance, meaning the relevance of the competence, in their opinion, for working in their profession.

- The level of achievement, meaning the achievement of this competence as a result of having taken this university degree.

To evaluate these two variables, the interviewer used a four-point scale: 1 = "none"; 2 = "weak"; 3 = "moderate"; 4 = "strong".

Based on the categorisation of the five most important competences according to academics, graduates, students and employers, a new variable was created for each competence. The competence that was ranked highest in the survey was allocated five points, four for the

second and so on, with one point for the last in the selection. If the competence was not chosen in the survey, it was scored zero points.

2.3. Consultation Process

The cluster sampling used acknowledged that the respondents were not strictly independent of each other, with the result that such sampling could not, in all probability, be considered random. At the same time, the universities have a certain clustering effect at the level of each country.

Identified competencies both specific and generic with the 4 groups of main stakeholders —Academics, Graduates, Employers and Students— were presented. Each participating university in the Applied Geology subject area group was requested to mobilise, in its home country, at least 30 responses for each stakeholders´ category. As the consultation was organised using internet connection, some remote areas in some countries such as DRC and Kenya, were not covered. In such cases, the survey was conducted using paper and the responses uploaded afterwards online. The SAG also decided to start consultation process as soon as possible to avoid constrains that could interfere and delay the process for example in the Katanga Province in the Democratic Republic of Congo where there is too much rain from December to February. In Rwanda there were no special constraints in the consultation process due to the limited size of the country, while in Nigeria, the size of the country imposed many constraints as the team needed to travel long distances to convince stakeholders to participate in the online consultation.

In every country, consultation process appeared more feasible for academics and students but for employers and graduates it was more challenging.

Other pertinent issues that arose included:

- Possibility of introducing an Arabic version of the consultation file for countries such as Libya where most students used Arabic language only.
- Consideration of work experience of the persons that were to be consulted.

- Problems of internet access in some areas.

- Relevance of considering more than 30 persons in some countries, in each category, to compensate for the number that could not be reached in some regions of those countries. It was advised to target not only 30 participants by stakeholders category but when possible, to increase the continental samples and to compensate the few countries where the minimum number of 30 for the 4 categories was not reached.

Whether, in the case of 'employers', the CEO or Managing Director was the one to be contacted or somebody else could be appointed by the targeted company for the consultation.

It was noted that company leaders usually do not accept invitations from universities in the event that they are expected to attend personally. In that scenario, it was imperative that the persons in authority be visited directly; although some of them were located far from university premises.

2.4. Conclusion

The Consultation at the end reached the expected target and increased the SAG conviction to strengthen the harmonisation of the Applied Geology degree programmes to be offered at continental level. All generic competences do have an appropriate Applied Geology explanation. The Cluster sampling methodology used was considered to be the most suitable, because as it is previously mentioned, it takes into account not only the structure of data clustering but also cluster designs which are widely used in research and do not represent a source of partiality. The outcomes of the consultation will be presented in following chapters.

Chapter 3

Generic and Subject-specific Competences

Voahangy Ratrimo, Najet Slim Ep Shimi and Digne Edmond Rwabuhungu

3.1. Introduction

According to Anderson *et al.* (2001) , knowledge can be subdivided into 4 types: 1) the factual knowledge that focus on details and terminologies; 2) the conceptual focus on models, theories, principles and classifications; 3) the procedural focus on methodology and use of specific skills; and 4) the metacognitive focus on problem solving strategies.

Competences are knowledge skills needed by a learner to be able to act adequately facing different situations. At Tuning Africa, competence-based learning is one of its core pillar (Onana *et al.*, 2014).

3.2. Generic Competences

Applied Geology SAG, adopted without important discussions the following 18 Generic competences.

G1. Capacity for conceptual thinking, analysis and synthesis: This competence is the ability of using geoscientific knowledge to solve the natural problems, analysing geological concepts and creating

the conceptual mentality that brings the possible solutions for the problems in the context of the Geoscientific areas.

G2. Professionalism, ethical values and commitment to UBUNTU: This is the professional quality to respect the norms, morals, cultures and ethical values of the community, employers, stakeholders and the working team in the projects and working areas based on the legal, human dignity in the context of the geological field works and official sectors.

G3. Capacity for critical evaluation and self-awareness: The ability to develop the capacity to solve critical problems to make decisions in the management of projects based on the strengths and weaknesses with respect to overcoming shortcomings as well as assessing the situation of the working areas in geological fields.

G4. Ability to translate knowledge into practice: This is the ability to adopt, apply and modify the basic geoscientific knowledge and applications into practice to solve the real life geological problems.

G5. Objective decision making and practical cost-effective problem solving: The ability to decide without bias in proposing feasible cost-effective solutions in the project management and supervision based on the effectiveness of the stakeholders that reduce the problem of the society in the geological context of resource exploration and exploitation.

G6. Capacity to use innovative and appropriate technologies: The ability to use the knowledge of innovation and has the knowledge of technologies relevant to the field of specialty of geology.

G7. Ability to communicate effectively in official /national and local language: Ability to convey information in an easy and understandable manner.

G8. Ability to learn to learn and capacity for lifelong learning: Ability to embrace new knowledge and to continue learning.

G9. Flexibility, adaptability and ability to anticipate and respond to new situations: A learner has an ability to cope with new realities.

G10. Ability for creative and innovative thinking: This is the ability to initiate new ideas (or concepts in Applied Geology), which will be applicable to new situations toward finding solutions to problems.

G11.Leadership, management and teamwork skills: These are skills (including conscientious work ethic, personal integrity and efficiency and planning capabilities) that enable one to function effectively in team or group work situations; especially the ability to take on the responsibility of leadership.

G12. Communication and interpersonal skills: Basically, at the universal level, this is the ability to be clear and articulate in verbal and body language as well as success in relating smoothly with people. In the context of Applied Geology, apart from verbal expression, communication includes proficiency in communicating technical information through media such as maps, charts, drawings and sketches, symbols and appropriate geologic models.

G13. Environmental and economic consciousness: This is the ability to develop a keen awareness of the connection or link between economic activity and their environmental impacts hence taking necessary measures to mitigate and manage geohazards and anthropogenic activities. For Applied Geologists this means understanding fully the environmental implications of such economic activity and the responsibility that this places on them to ensure preservation of the environment.

G14. Ability to work in an intra- and intercultural and/or international context: This is the ability to work well with people of all races or ethnic background whether in one's home base or in a foreign setting. This involves understanding of different cultures.

G15. Ability to work independently: This is the ability to work well, i.e. efficiently and effectively with minimum supervision in one's working environment to achieve desired results. For the Applied Geologist, this means that he/she must know the right sources of information, including reference books, field work data, web-based data, journals and textbooks.

G16. Ability to evaluate, review and enhance quality: This is the ability to determine, enhance and take appropriate steps

of the technical geological studies. For an Applied Geologist, it is the capacity to use technical tools to assess, interpret and analyse geological data.

G17. Self-confidence, entrepreneurial spirit and skills: This is the quality of being sure of oneself in terms of acumen and ability to deliver goods and services from an entrepreneurial point of view (such as small and large-scale business). For Applied Geologists, such self-confidence is usually derived from the authority of technical competence and proficiency. It therefore requires the ability to learn fast on the job to drive out the self-doubt syndrome.

G18. Commitment to preserve African identity and cultural heritage: This refers to one's pride of the African cultural heritage and one's commitment and contribution to the preservation and promotion of Africa identity, creative thinking and innovations.

3.3. Specific Competences formulated by the SAG

After adopting the generic competences and carrying out consultations, round table group discussions were organised to establish the subject-specific competences and their respective definitions.

Based on the definition provided on chapter two, specific competences were progressively drawn upon many contexts and field experiences of group members in order to provide graduates with geological knowledge, principles and techniques to solve problems not only in exploration and exploitation of Natural resources, but also in Geotechnics, in Environmental protection and in all Geohazards situations.

The specific competences adopted by the Applied Geology group are the following:

S1: Ability to apply earth sciences knowledge and techniques to design a mining engineering project. This is the ability of using the basic geoscientific knowledge such as subsurface geological formation, geomorphological, structural and rock mechanics; to decide about the feasibility and methods of exploitation of mineral resources and also to supervise the project.

S2: Ability to find, characterise and estimate natural resources. This is the ability to locate and evaluate a natural resources deposit area using the methods of geological mapping, geophysical, geochemical, geostatistics and remote sensing and geographic information system data.

S3: Ability to understand the origin and the evolution of earth and its components. This is the ability to identify the geodynamics of the earth and evolution of the solar system.

S4: Ability to collect, map, analyse and interpret geological data using various geoscientific techniques. This is the ability forfield geological data collection, producing map, analysing the field data in the laboratory, interpretation of the result using different geological software and modeling techniques.

S5: Ability to use methods and techniques of natural resources exploration and exploitation. The ability to use the knowledge of geophysics, remote sensing, GIS, geochemistry and mining exploration and exploitation.

S6: Ability to evaluate environmental impact of natural resources exploitation. The ability to use the tools of environmental impact assessment (EIA).

S7: Ability to conduct geotechnical site investigation. The ability to apply knowledge of engineering geology for infrastructures development.

S8: Ability to identify the genesis, types and uses of geological materials. The ability to utilise the knowledge of geology of ore deposit, petrogenesis of metamorphic and igneous and sedimentary rock forming process and their economic importance.

S9: Ability to use and/or develop modern analytical and numerical techniques in geological solving problems. This is the ability to develop or use modern analytical and numerical techniques to solve problems based on strong numerical skills and the use of appropriate application softwares.

S10: Ability to evaluate socio-economic impacts of geological resources and their utilisation. This is the ability to understand

geological resources and their uses and the socio-economic impact of their exploitation; to ensure they are exploited in a sustainable and environmentally friendly manner.

S11: Ability to monitor, assess and plan risk mitigation management in case of Geohazards. This is the ability to recognise potential Geohazards, and to plan risk mitigation and management strategies.

S12: Ability to implement health and safety legislation in geological resources exploitation. The applied geologist should have a very good understanding of health and safety legislation and ensure that they are implemented in geological resources exploitation.

S13: Ability to use geological projects for sustainable development. This is the ability to plan, manage large scale geological projects in mining, construction and manufacturing industries in sustainable development.

S14: Perceiving and understanding the time-space dimension of geological processes and their effects on the planet. Basically, at the universal level, this is the ability to understand geological processes in terms of erosion, geo-environmental hazards in a dynamic earth system.

S15: Ability to contribute with the knowledge on georesources for engineering projects. The ability to acquire technical knowledge, creative skills and positive attitudes for engaging in construction projects and in mining industries.

S16: Ability to demonstrate knowledgeable geoscientific expertise in entrepreneurial and managerial skills. The ability to acquire geoscientific knowledge, entrepreneurial and management skills for mobilising natural resources.

S17: Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice. Ability to effectively carry out petrological and laboratory protocols for geoscientific and construction purposes.

3.4. Conclusion

The 17 Subject-specific Competences are common to all partners in the SAG and are all likely to be needed at BSc level. However, they were left opened for future updatings / improvements. The group also assigned a number to each specific competence by order of priority; but it was decided on this respect to use the consultation process in order to verify that all 4 main stakeholders do have the same criteria on the priority.

Chapter 4

Analysis and Results of Consultation

Mohamed Awa, Ayonma Wilfred Mode and Digne Edmond Rwabuhungu

4.1. Introduction

Prior to the analysis of the consultation results, it is important to understand the consultation itself, starting by the *Methodology of the Consultation Process.* Within Tuning projects, SAG members decide to use a system of cluster sampling, presented in chapter 2, given that the people surveyed are grouped by universities. *Two v*ariables are measured: (1) the *degree of importance,* meaning the relevance of the competence in their opinion, and (2) *the level of achievement*, meaning the achievement of this competence as a result of having developed / obtained it within Applied Geology BSc degree. In order to evaluate these two variables, the interviewer used a four-point scale: 1 = "none"; 2 = "weak"; 3 = "moderate"; 4 = "strong".

4.1.1. *The consultation process*

The variables were defined and agreements were reached on the number of participants per stakeholder to be consulted as follows:

- Academics: University lecturers teaching in any of the eight subject area of the project. Each university was asked to sample at least 30 academics in its area.
- Graduates: People who had successfully completed a full degree programme, in any of the eight subject area of the project. Each

participating university was asked to survey at least 30 graduates in its area. Selected graduates must have received their degree three to five years before the date of the survey. This criterion varied according to the number of graduates who had obtained their degree during this period. If the number of graduates was fewer than the number agreed, the sample had to include graduates from up to five previous years; otherwise it was restricted to the three previous years.

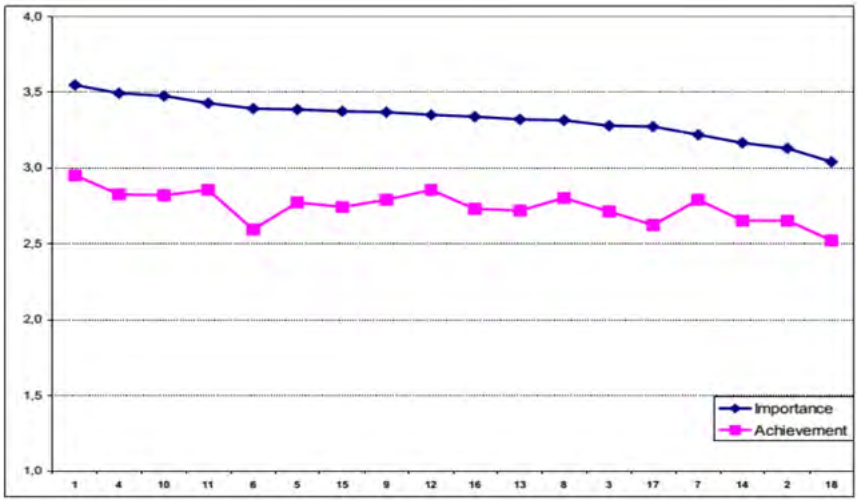
- Students: People either engaged in the last two years on a first degree in any of the eight areas within the participating universities or still awaiting graduation despite having completed their studies. Each university was asked to sample a minimum of 30 students in its subject area.

- Employers: People and/or organisations who have employed graduates from the university, or people and/or organisations which, although there is no evidence of having hired graduates from the university, appear to have jobs of interest for graduates. Each university was asked to survey at least 30 employers of graduates in its subject area.

The main discussions of the SAG focused on the perceived importance and degree of realisation of the generic and subject-specific competences. The group noted that achievement was generally inferior to importance for all subject-specific and generic skills. Brain storming emphasised the significance of Importance, Ranking and Achievement as well as the identification of gaps so as to determine where intervention was needed, even for the most important skills that need to be properly addressed.

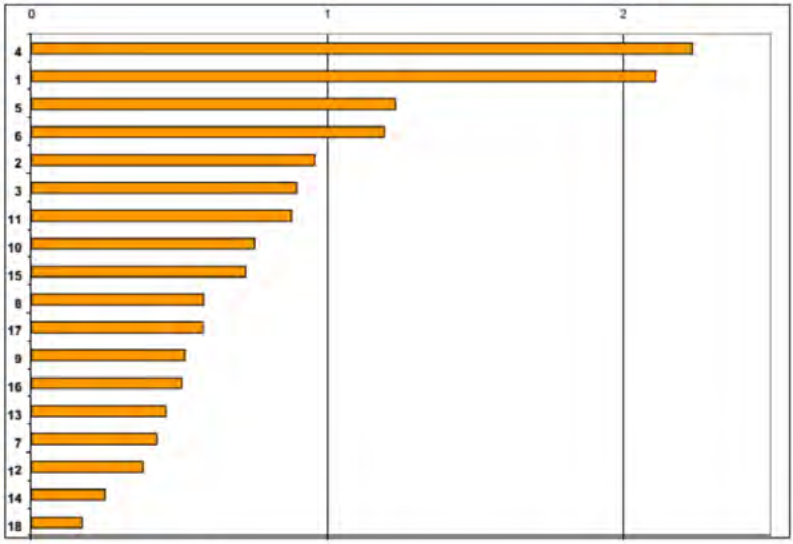
4.2. Graphical Results for Generic Competence investigations

Academics - Applied Geology - Ratings



#	Description	Importance	Achievement
1	Capacity for conceptual thinking, analysis and synthesis	3,55	2,96
4	Ability to translate knowledge into practice	3,50	2,83
10	Self- confidence, ability for creative and innovative thinking	3,48	2,82
11	Capacity to demonstrate leadership, management and teamwork skills professionally	3,43	2,85
6	Capacity to use innovative and appropriate technologies	3,39	2,60
5	Ability to take relevant and objective decisions...	3,39	2,77
15	Ability to take initiatives and work independently	3,38	2,74
9	Ability to demonstrate flexibility and adaptability to new situations	3,37	2,79
12	Ability to communicate effectively and demonstrate interpersonal skills	3,35	2,86
16	Ability to evaluate, review and enhance quality	3,34	2,73
13	Sustainable environmental awareness and economic consciousness...	3,32	2,72
8	Ability to learn to learn, and capacity for lifelong learning	3,31	2,80
3	Capacity for critical thinking, evaluation and self-awareness	3,28	2,72
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	3,27	2,63
7	Ability to communicate effectively in official and local languages	3,22	2,79
14	Ability to work in an intra- and intercultural and/or international context	3,17	2,66
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	3,13	2,66
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	3,04	2,52

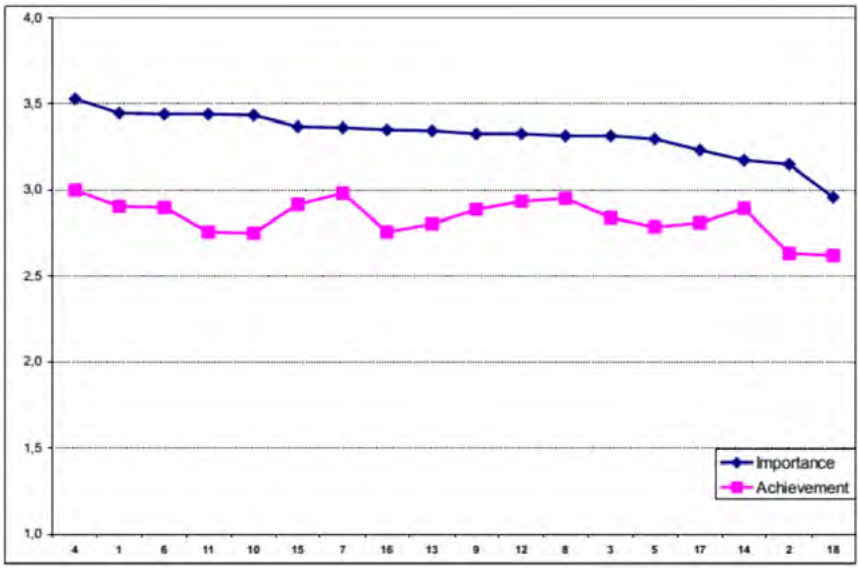
Academics - Applied Geology - Rankings



GENERIC Competences

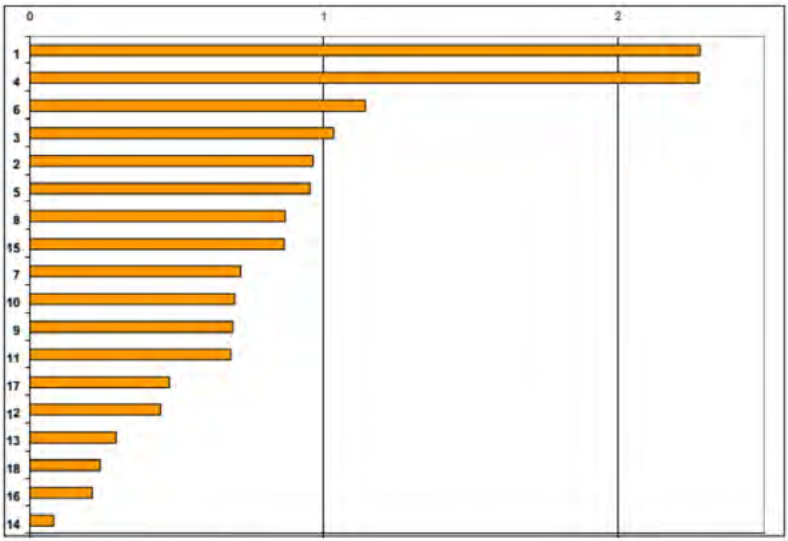
#	Description	Ranking
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	0,17
14	Ability to work in an intra- and intercultural and/or international context	0,25
12	Ability to communicate effectively and demonstrate interpersonal skills	0,38
7	Ability to communicate effectively in official and local languages	0,43
13	Sustainable environmental awareness and economic consciousness...	0,45
16	Ability to evaluate, review and enhance quality	0,51
9	Ability to demonstrate flexibility and adaptability to new situations	0,52
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	0,58
8	Ability to learn to learn, and capacity for lifelong learning	0,58
15	Ability to take initiatives and work independently	0,72
10	Self- confidence, ability for creative and innovative thinking	0,75
11	Capacity to demonstrate leadership, management and teamwork skills professionally	0,88
3	Capacity for critical thinking, evaluation and self-awareness	0,90
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	0,96
6	Capacity to use innovative and appropriate technologies	1,19
5	Ability to take relevant and objective decisions...	1,23
1	Capacity for conceptual thinking, analysis and synthesis	2,11
4	Ability to translate knowledge into practice	2,23

Employers / Applied Geology - Ratings



#	Description	Importance	Achievement
4	Ability to translate knowledge into practice	3,53	3,00
1	Capacity for conceptual thinking, analysis and synthesis	3,44	2,90
6	Capacity to use innovative and appropriate technologies	3,44	2,90
11	Capacity to demonstrate leadership, management and teamwork skills professionally	3,44	2,76
10	Self- confidence, ability for creative and innovative thinking	3,43	2,75
15	Ability to take initiatives and work independently	3,37	2,92
7	Ability to communicate effectively in official and local languages	3,36	2,98
16	Ability to evaluate, review and enhance quality	3,35	2,76
13	Sustainable environmental awareness and economic consciousness...	3,34	2,81
9	Ability to demonstrate flexibility and adaptability to new situations	3,33	2,89
12	Ability to communicate effectively and demonstrate interpersonal skills	3,33	2,94
8	Ability to learn to learn, and capacity for lifelong learning	3,32	2,95
3	Capacity for critical thinking, evaluation and self-awareness	3,32	2,84
5	Ability to take relevant and objective decisions...	3,30	2,78
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	3,23	2,81
14	Ability to work in an intra- and intercultural and/or international context	3,17	2,90
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	3,15	2,63
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	2,96	2,62

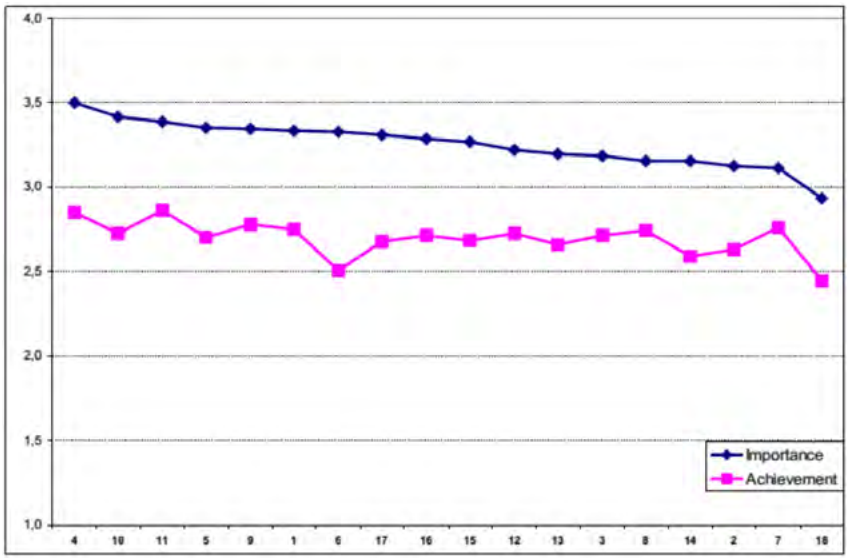
Employers / Applied Geology - Rankings



GENERIC Competences

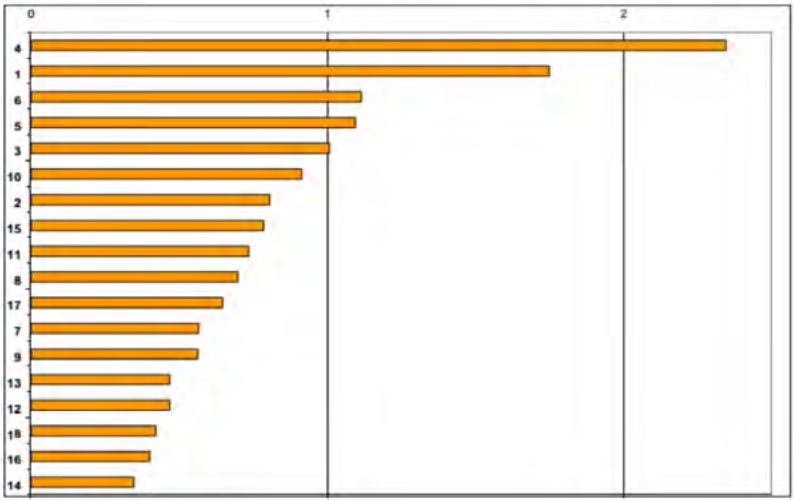
#	Description	Ranking
14	Ability to work in an intra- and intercultural and/or international context	0,08
16	Ability to evaluate, review and enhance quality	0,21
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	0,24
13	Sustainable environmental awareness and economic consciousness...	0,29
12	Ability to communicate effectively and demonstrate interpersonal skills	0,45
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	0,47
11	Capacity to demonstrate leadership, management and teamwork skills professionally	0,69
9	Ability to demonstrate flexibility and adaptability to new situations	0,69
10	Self- confidence, ability for creative and innovative thinking	0,70
7	Ability to communicate effectively in official and local languages	0,72
15	Ability to take initiatives and work independently	0,87
8	Ability to learn to learn, and capacity for lifelong learning	0,87
5	Ability to take relevant and objective decisions...	0,95
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	0,96
3	Capacity for critical thinking, evaluation and self-awareness	1,04
6	Capacity to use innovative and appropriate technologies	1,14
4	Ability to translate knowledge into practice	2,28
1	Capacity for conceptual thinking, analysis and synthesis	2,28

Students / Applied Geology - Ratings



#	Description	Importance	Achievement
4	Ability to translate knowledge into practice	3,50	2,85
10	Self- confidence, ability for creative and innovative thinking	3,42	2,72
11	Capacity to demonstrate leadership, management and teamwork skills professionally	3,39	2,86
5	Ability to take relevant and objective decisions...	3,35	2,70
9	Ability to demonstrate flexibility and adaptability to new situations	3,34	2,78
1	Capacity for conceptual thinking, analysis and synthesis	3,33	2,75
6	Capacity to use innovative and appropriate technologies	3,33	2,50
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	3,31	2,68
16	Ability to evaluate, review and enhance quality	3,29	2,71
15	Ability to take initiatives and work independently	3,27	2,68
12	Ability to communicate effectively and demonstrate interpersonal skills	3,22	2,73
13	Sustainable environmental awareness and economic consciousness...	3,20	2,66
3	Capacity for critical thinking, evaluation and self-awareness	3,18	2,72
8	Ability to learn to learn, and capacity for lifelong learning	3,16	2,74
14	Ability to work in an intra- and intercultural and/or international context	3,15	2,59
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	3,12	2,63
7	Ability to communicate effectively in official and local languages	3,11	2,76
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	2,94	2,44

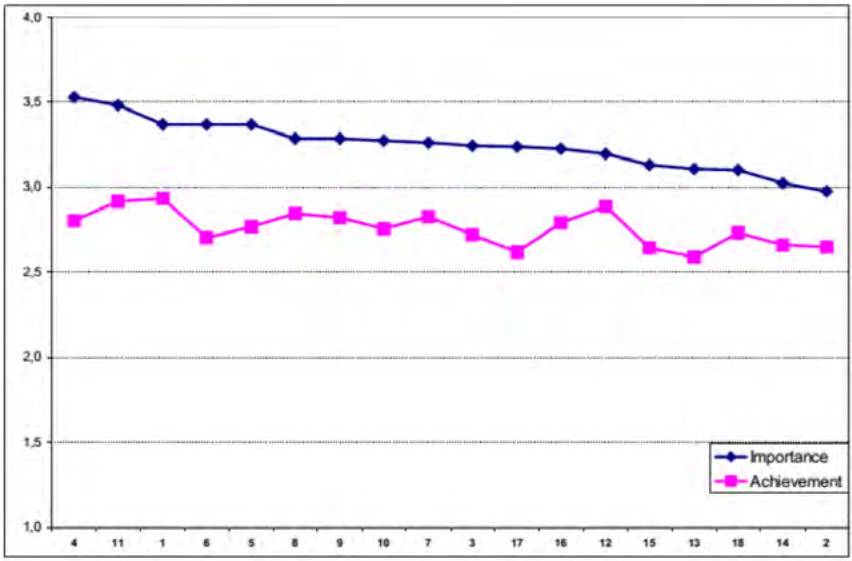
Students / Applied Geology - Rankings



GENERIC Competences

#	Description	Ranking
14	Ability to work in an intra- and intercultural and/or international context	0,35
16	Ability to evaluate, review and enhance quality	0,40
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	0,42
12	Ability to communicate effectively and demonstrate interpersonal skills	0,47
13	Sustainable environmental awareness and economic consciousness...	0,47
9	Ability to demonstrate flexibility and adaptability to new situations	0,56
7	Ability to communicate effectively in official and local languages	0,57
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	0,65
8	Ability to learn to learn, and capacity for lifelong learning	0,70
11	Capacity to demonstrate leadership, management and teamwork skills professionally	0,74
15	Ability to take initiatives and work independently	0,78
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	0,80
10	Self- confidence, ability for creative and innovative thinking	0,91
3	Capacity for critical thinking, evaluation and self-awareness	1,01
5	Ability to take relevant and objective decisions...	1,09
6	Capacity to use innovative and appropriate technologies	1,11
1	Capacity for conceptual thinking, analysis and synthesis	1,75
4	Ability to translate knowledge into practice	2,34

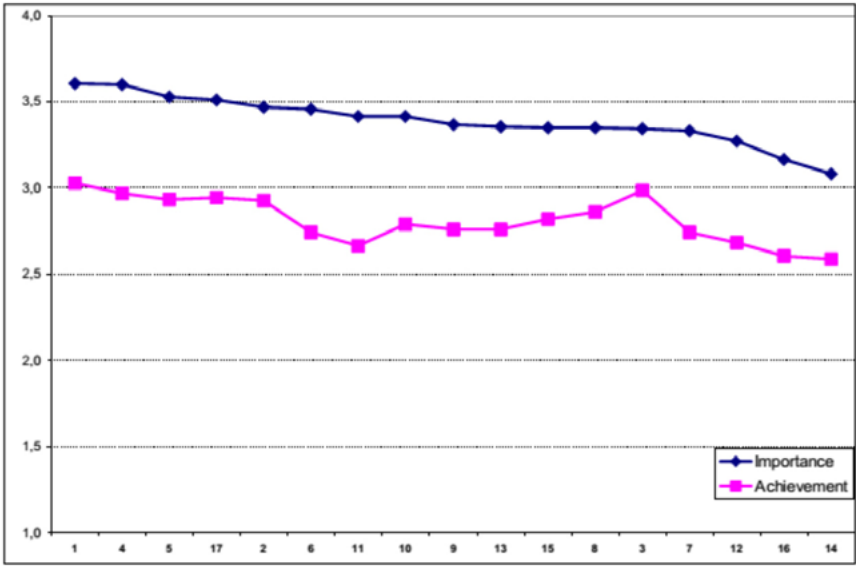
Graduates / Applied Geology - Ratings



#	Description	Importance	Achievement
4	Ability to translate knowledge into practice	3,53	2,80
11	Capacity to demonstrate leadership, management and teamwork skills professionally	3,48	2,91
1	Capacity for conceptual thinking, analysis and synthesis	3,37	2,94
6	Capacity to use innovative and appropriate technologies	3,37	2,70
5	Ability to take relevant and objective decisions...	3,37	2,77
8	Ability to learn to learn, and capacity for lifelong learning	3,29	2,84
9	Ability to demonstrate flexibility and adaptability to new situations	3,28	2,82
10	Self- confidence, ability for creative and innovative thinking	3,28	2,75
7	Ability to communicate effectively in official and local languages	3,26	2,83
3	Capacity for critical thinking, evaluation and self-awareness	3,24	2,72
17	Ability to manifest self-confidence and to exhibit / translate knowledge...	3,24	2,62
16	Ability to evaluate, review and enhance quality	3,23	2,79
12	Ability to communicate effectively and demonstrate interpersonal skills	3,20	2,88
15	Ability to take initiatives and work independently	3,13	2,65
13	Sustainable environmental awareness and economic consciousness...	3,11	2,59
18	Commitment to preserve and add value to Africa's identities, diversity and cultural heritage	3,10	2,73
14	Ability to work in an intra- and intercultural and/or international context	3,02	2,66
2	Ability to work professionally with respect to ethical values and commitment to Ubuntu	2,98	2,65

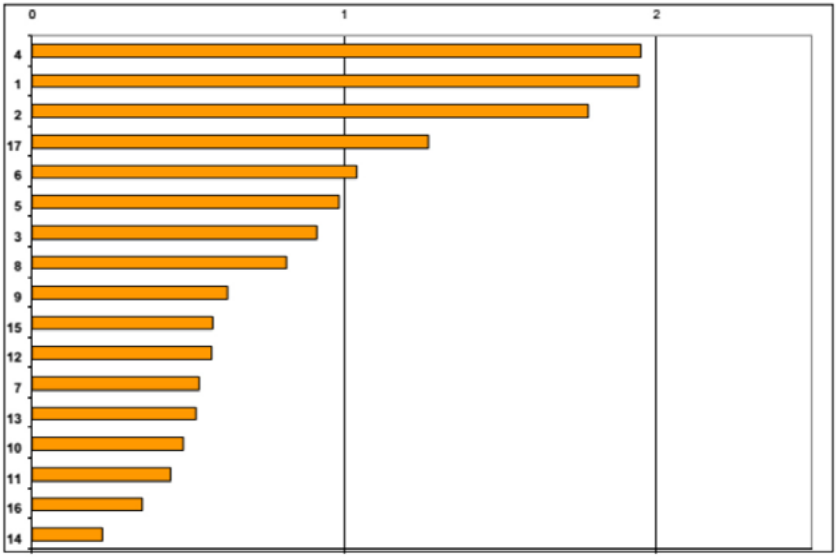
4.3. Graphical Results for Subject-specific Competence Investigations

Academics - Applied Geology - Ratings



#	Description	Importance	Achievement
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	3,61	3,03
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	3,60	2,97
5	Ability to use methods and techniques of natural resources exploration and exploitation	3,53	2,94
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	3,51	2,95
2	Ability to find, characterise and estimate natural resources	3,47	2,93
6	Ability to evaluate environmental impact of natural resources exploitation	3,46	2,74
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	3,42	2,67
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	3,42	2,79
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	3,37	2,76
13	Ability to use geological projects for sustainable development	3,35	2,76
15	Ability to contribute with the knowledge on georesources for engineering projects	3,35	2,82
8	Ability to identify the genesis, types and uses of geological materials	3,35	2,87
3	Ability to understand the origin and the evolution of earth and its components	3,35	2,99
7	Ability to conduct geotechnical site investigation	3,34	2,74
12	Ability to implement health and safety legislation in geological resources exploitation	3,27	2,69
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	3,17	2,61
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	3,08	2,59

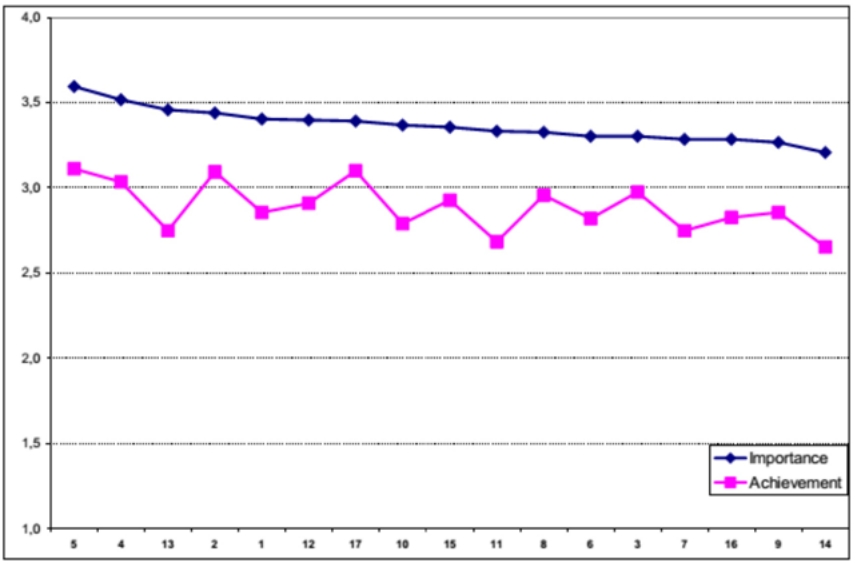
Academics / Applied Geology - Rankings



SPECIFIC Competences

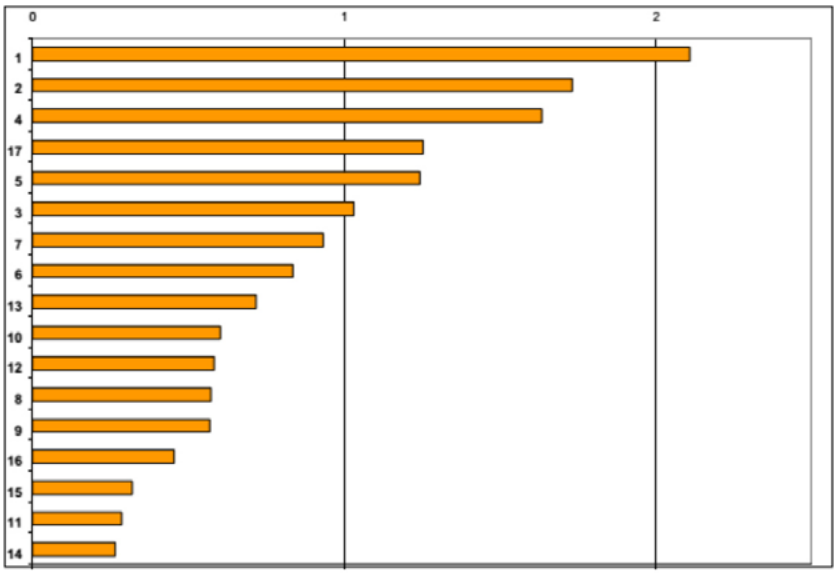
#	Description	Ranking
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	0,22
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	0,35
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	0,44
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	0,48
13	Ability to use geological projects for sustainable development	0,53
7	Ability to conduct geotechnical site investigation	0,53
12	Ability to implement health and safety legislation in geological resources exploitation	0,58
15	Ability to contribute with the knowledge on georesources for engineering projects	0,58
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	0,63
8	Ability to identify the genesis, types and uses of geological materials	0,82
3	Ability to understand the origin and the evolution of earth and its components	0,91
5	Ability to use methods and techniques of natural resources exploration and exploitation	0,98
6	Ability to evaluate environmental impact of natural resources exploitation	1,04
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	1,27
2	Ability to find, characterise and estimate natural resources	1,78
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	1,95
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	1,95

Employers - Applied Geology - Ratings



#	Description	Importance	Achievement
5	Ability to use methods and techniques of natural resources exploration and exploitation	3,60	3,11
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	3,52	3,03
13	Ability to use geological projects for sustainable development	3,46	2,75
2	Ability to find, characterise and estimate natural resources	3,44	3,10
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	3,40	2,86
12	Ability to implement health and safety legislation in geological resources exploitation	3,40	2,91
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	3,39	3,10
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	3,37	2,79
15	Ability to contribute with the knowledge on georesources for engineering projects	3,36	2,93
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	3,33	2,69
8	Ability to identify the genesis, types and uses of geological materials	3,32	2,96
6	Ability to evaluate environmental impact of natural resources exploitation	3,30	2,82
3	Ability to understand the origin and the evolution of earth and its components	3,30	2,98
7	Ability to conduct geotechnical site investigation	3,29	2,75
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	3,28	2,82
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	3,27	2,86
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	3,21	2,66

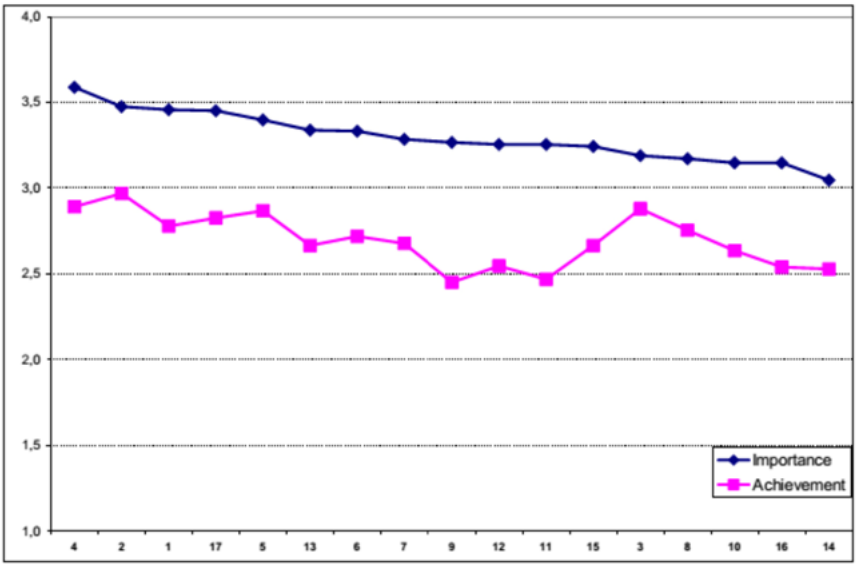
Employers - Applied Geology - Rankings



SPECIFIC Competences

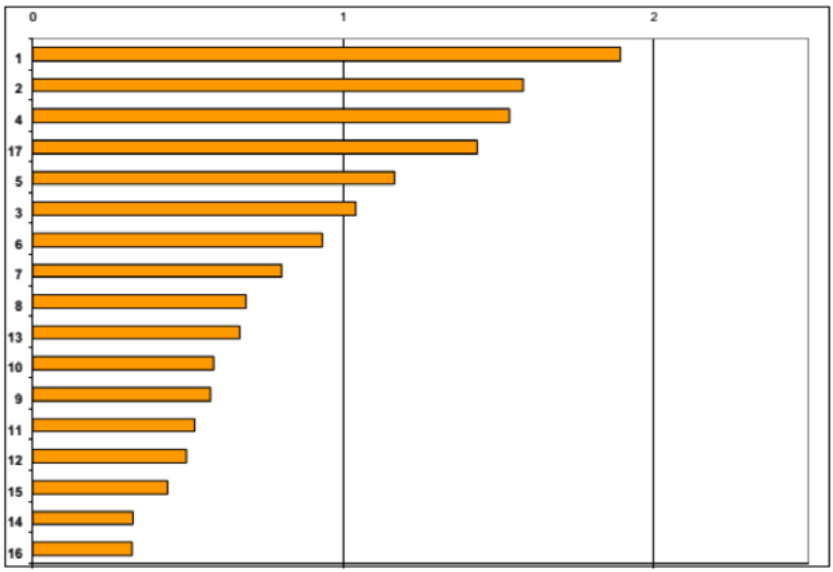
#	Description	Ranking
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	0,27
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	0,29
15	Ability to contribute with the knowledge on georesources for engineering projects	0,32
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	0,46
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	0,57
8	Ability to identify the genesis, types and uses of geological materials	0,57
12	Ability to implement health and safety legislation in geological resources exploitation	0,58
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	0,60
13	Ability to use geological projects for sustainable development	0,72
6	Ability to evaluate environmental impact of natural resources exploitation	0,83
7	Ability to conduct geotechnical site investigation	0,93
3	Ability to understand the origin and the evolution of earth and its components	1,03
5	Ability to use methods and techniques of natural resources exploration and exploitation	1,24
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	1,25
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	1,63
2	Ability to find, characterise and estimate natural resources	1,73
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	2,11

Students - Applied Geology - Ratings



4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	3,59	2,89
2	Ability to find, characterise and estimate natural resources	3,47	2,97
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	3,46	2,78
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	3,45	2,83
5	Ability to use methods and techniques of natural resources exploration and exploitation	3,40	2,87
13	Ability to use geological projects for sustainable development	3,34	2,67
6	Ability to evaluate environmental impact of natural resources exploitation	3,33	2,72
7	Ability to conduct geotechnical site investigation	3,28	2,68
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	3,27	2,45
12	Ability to implement health and safety legislation in geological resources exploitation	3,26	2,55
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	3,26	2,47
15	Ability to contribute with the knowledge on georesources for engineering projects	3,24	2,66
3	Ability to understand the origin and the evolution of earth and its components	3,19	2,88
8	Ability to identify the genesis, types and uses of geological materials	3,17	2,75
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	3,15	2,64
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	3,15	2,54
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	3,05	2,53

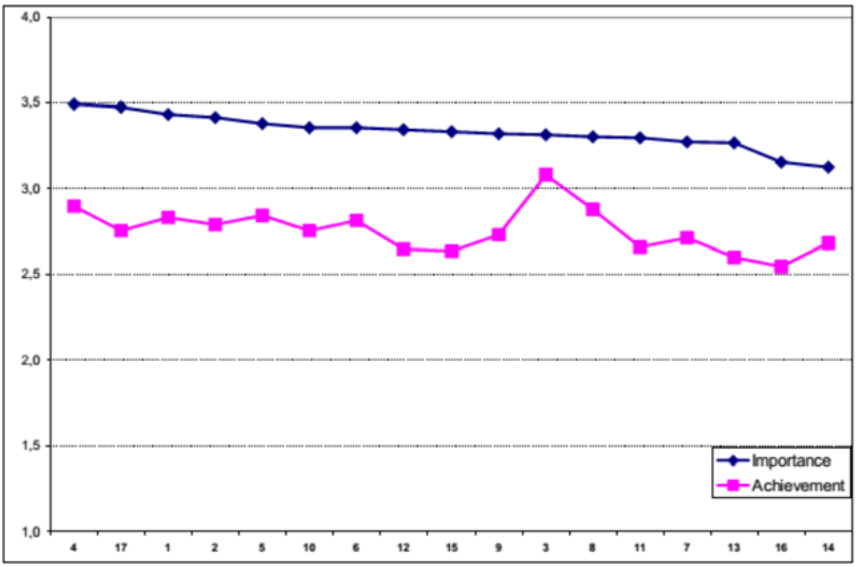
Students - Applied Geology - Rankings



SPECIFIC Competences

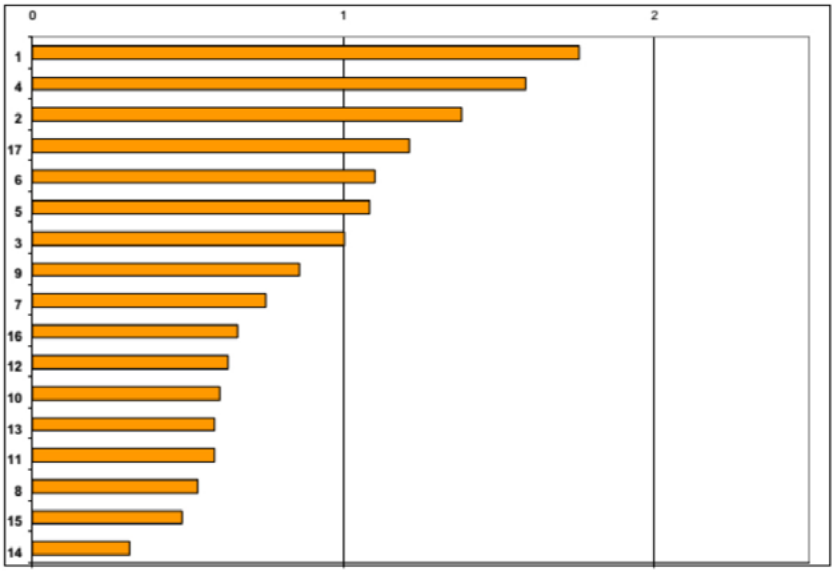
#	Description	Ranking
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	0,32
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	0,32
15	Ability to contribute with the knowledge on georesources for engineering projects	0,43
12	Ability to implement health and safety legislation in geological resources exploitation	0,50
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	0,52
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	0,57
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	0,58
13	Ability to use geological projects for sustainable development	0,67
8	Ability to identify the genesis, types and uses of geological materials	0,69
7	Ability to conduct geotechnical site investigation	0,80
6	Ability to evaluate environmental impact of natural resources exploitation	0,93
3	Ability to understand the origin and the evolution of earth and its components	1,04
5	Ability to use methods and techniques of natural resources exploration and exploitation	1,16
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	1,43
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	1,54
2	Ability to find, characterise and estimate natural resources	1,58
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	1,89

Graduates - Applied Geology - Ratings



#	Description	Importance	Achievement
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	3,50	2,90
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	3,48	2,76
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	3,44	2,83
2	Ability to find, characterise and estimate natural resources	3,42	2,79
5	Ability to use methods and techniques of natural resources exploration and exploitation	3,38	2,84
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	3,36	2,76
6	Ability to evaluate environmental impact of natural resources exploitation	3,36	2,81
12	Ability to implement health and safety legislation in geological resources exploitation	3,35	2,65
15	Ability to contribute with the knowledge on georesources for engineering projects	3,34	2,63
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	3,32	2,73
3	Ability to understand the origin and the evolution of earth and its components	3,32	3,08
8	Ability to identify the genesis, types and uses of geological materials	3,30	2,88
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	3,30	2,66
7	Ability to conduct geotechnical site investigation	3,27	2,71
13	Ability to use geological projects for sustainable development	3,27	2,60
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	3,15	2,54
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	3,13	2,69

Graduates - Applied Geology - Rankings



SPECIFIC Competences

#	Description	Ranking
14	Perceiving and understanding the time-space dimension of geological processes and their effects on the planet	0,31
15	Ability to contribute with the knowledge on georesources for engineering projects	0,48
8	Ability to identify the genesis, types and uses of geological materials	0,53
11	Ability to monitor, assess and plan risk mitigation management in case of Geohazards	0,59
13	Ability to use geological projects for sustainable development	0,59
10	Ability to evaluate socio-economic impacts of geological resources and their utilisation	0,60
12	Ability to implement health and safety legislation in geological resources exploitation	0,63
16	Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills	0,66
7	Ability to conduct geotechnical site investigation	0,75
9	Ability to use and/or develop modern analytical and numerical techniques in geological solving problems	0,86
3	Ability to understand the origin and the evolution of earth and its components	1,00
5	Ability to use methods and techniques of natural resources exploration and exploitation	1,09
6	Ability to evaluate environmental impact of natural resources exploitation	1,10
17	Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice	1,21
2	Ability to find, characterise and estimate natural resources	1,38
4	Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques	1,59
1	Ability to apply earth sciences knowledge and techniques to design a mining engineering project	1,76

4.4. Consultation Results

As it was earlier indicated, the survey asked participants to rate each competence on a four point scale, in which 1 = "none", 2 = "weak," 3 = "moderate" and 4 = "strong". Respondents rated each competence according to its perceived "***Importance***" in the workplace and their institution's level of "***Achievement***" in imparting this competence. In addition, respondents ranked the five most important generic and subject-specific competences. The rating exercise done refers to the means for each comptence in the 1 to 4 scale. Graphic displays result ordered from most important to least important competence even if the mean for achievement dones not follow strictly a descending pattern. It also appeared globaly that the meaning for achievement is normally lower than the meaning for importance. This is not a surprise as it has also been the case in other previous Tuning studies Onana *et al.*, 2014 for example. Most important is the gap between both mean as it shows how far both means are. Another indicator is when a wide gap appears between two competences and if the competence in question is rated as a highly important one.

The numbers of responses were 817 for Generic Competences and 688 for Subject-specific Competences.

Difference in numbers was most probably due to the fact that the two lists were sent separately to participants; some of them answered the first one and ignored the second one. Table 4.1 presents the details of respondents for both generic and subject-specific competences.

Table 4.1
Number of respondents

Competences	Academics	Employers	Students	Graduates	Total
Generic	162	113	321	221	817
Specific	142	109	258	179	688

Classification is based on the five most important competences ranking. In order to analyse the results, the first chosen competence was assigned 5 points, the second one 4 points, the third one 3 points, the fourth 2 points and 1 point to the fifth and last one. Unselected

competences were assigned zero point. Therefore, if all respondents had chosen one given competence as their first one in ranking, the assigned score would yied a top 5 for the meaning of this competence. Similarly, a given competence not chosen by any of the respondents among the top five would yield a zero score.

The main outcomes of the 4 groups of people consulted are presented as follows.

4.4.1. *For Academics*

- Importance: Between 3.55 to 2.99 for generic comptences and between 3.61 to 3.08 for subject-specific competences.

- Achievement: Between 2.66 and 2.28 for generic competences and between 3.03 and 2.59 for subject-specific competences. A big gap is observed for only the competence number 11. This is much lower than expected and seems to be at odds with the generic skills related to the environment, number 2 for example. This proved that there was a misunderstanding of Ubuntu. This remark apparently applies also to number 6, which was in some aspect similar to number 11.

- Classifications: The highest rankings observed for subject-specific competences were numbers 4, 1 and 2 and, the lowest for 14 and 16. We believe that possible reasons could have been that number 14 consisted of the most basic geology. It also appears for number 16, entrepreneurships were missing.

4.4.2. *For Employers*

- Importance: Between 3.52 to 3.01 for generic competences and between 3.60 to 3.21 for subject-specific comptences.

- Achievement: Between 2.86 and 2.43 for generic competences and between 3.11 and 2.66 for subject-specific competences there were several shortcomings which meant that several areas of Applied Geology were covered. Competence number 13 was related to the missing one on entrepreneurship while number 11 was, as for academics, related to Geohazards (environment) and management

issues. Most employers consulted misunderstood the importance of fundamental geology. They focus on the immediate results to make their income.

- Classifications: The highest rankings observed for subject-specific competences were numbers 1, 2 and 4 and the lowest for 11 and 14. We believe that possible reasons could have been that number 14 consisted of the most basic geology. For geohazard and risk mitigation it is unfortunately not considered by employers before its consequences appears.

4.4.3. *For Students*

- Importance: Between 3.51 to 2.99 for generic competences and between 3.59 to 3.05 for subject-specific competences.

- Achievement: Between 2.71 and 2.37 for generic competences and between 2.89 and 2.53 for subject-specific competences.

- Classifications: The highest rankings observed for subject-specific competences were numbers 1, 2 and 4 and the lowest for 16 and 14.

For subject-specific competences 9, 12 and 11; there was a high anomaly whereby students felt that skills were less affected. Thus, it was believed that there was a need for additional seminars to be conducted on skills competences that are related to innovative technologies and digital techniques. For competence number 11, it was found to have been least affected given that students needed more practical things (refer to number 3 for more clarity).

4.4.4. *For Graduates*

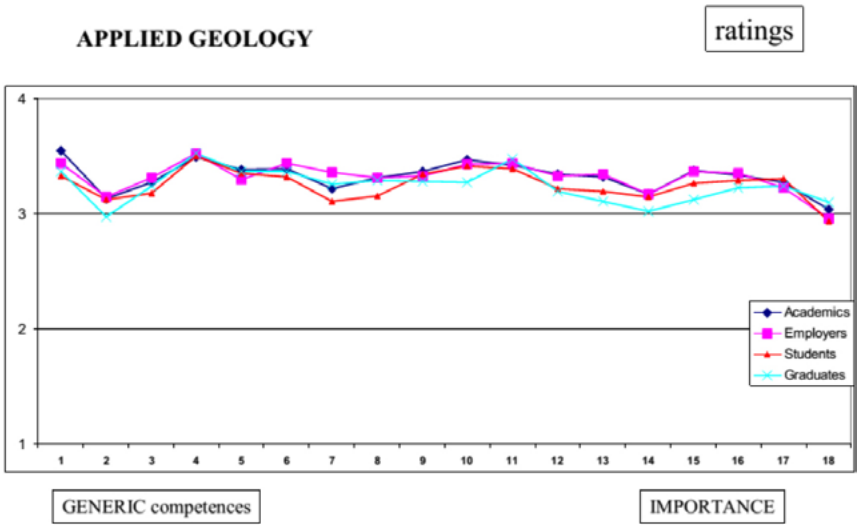
- Importance: Between 3.53 to 2.98 for generic competences and between 3.50 to 3.13 for subject-specific competences.

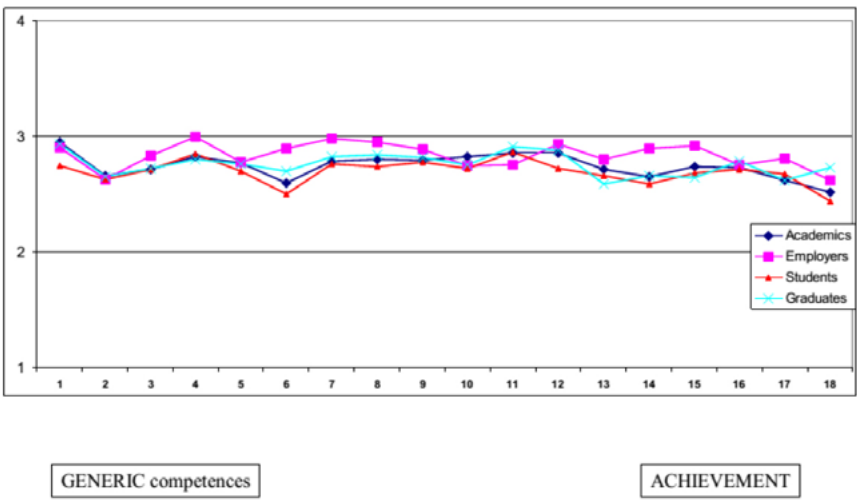
- Achievement: Between 2.80 and 2.65 for generic comptences and between 2.90 and 2.69 for subject-specific comptences.

- Classifications: The highest rankings observed for subject-specific competences were numbers 1, 4 and 2 and the lowest for 14 and 15.

4.5. Correlations

From the proposed generic competences as ranked by the four surveyed groups (Employers, Academics, Graduates and Students), we can observe the following:

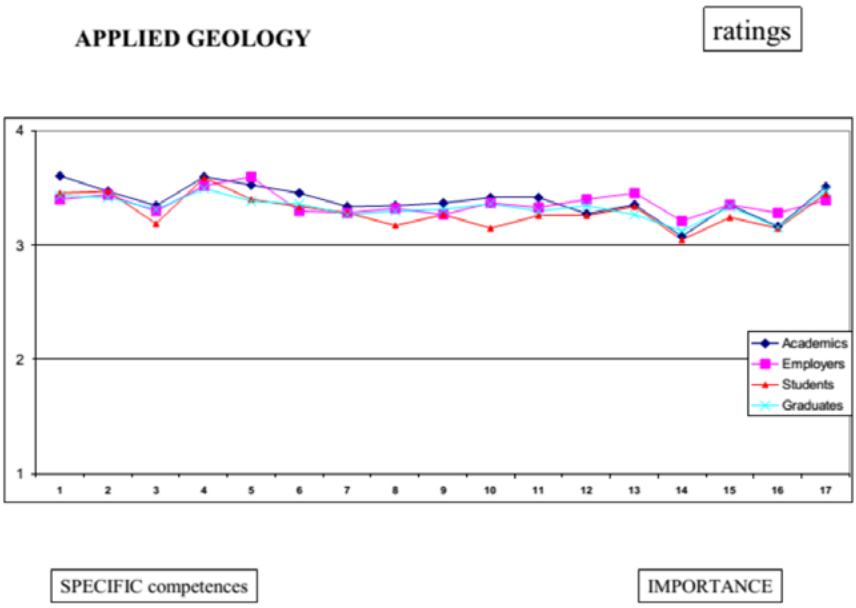


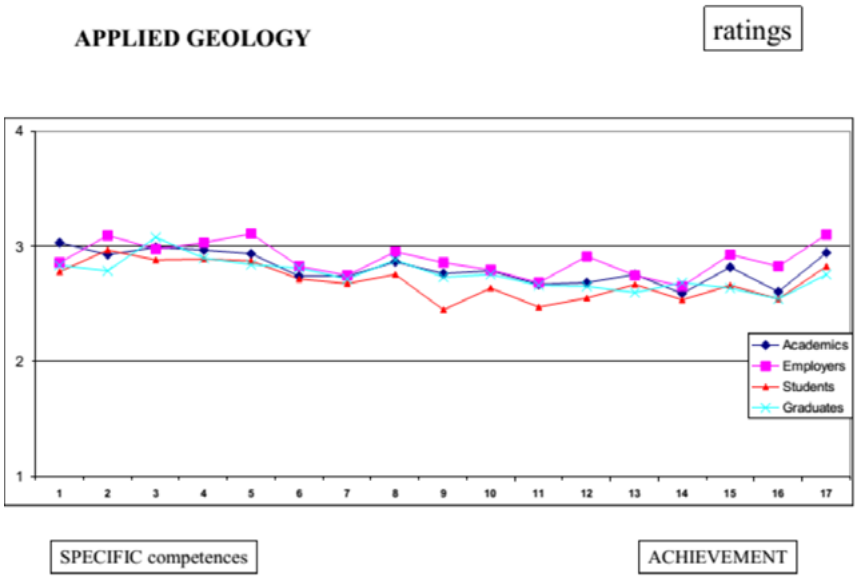


- The graph exhibits clearly that most competences are rated over 3.0; this is a strong indication that competences generated in Tuning Africa phase I were very appropriate also for Applied Geology in Tuning Africa phase II on importance variable. On the achievement variable, all competences are rated over 2.5 for the same reasons.

- Another point worth mentioning is the fact that academics and/or students have the lowest rating of the four groups on achievement variable with (12 competences having lower score). On importance variable, graduates group have the lowest rating of the four groups with (15 competences got having a lower score).

From defined subject-specific competences as ranked by the four surveyed groups (Employers, Academics, Graduates and Students) we can observe the following:





- That most competences are rated also over 3.0; a strong indication that competences generated on importance variable are line with the stakeholders' views. On the achievement variable except for competence 9 and 11 for students group, all competences are rated over 2.5 for the same reasons.

- The fact that students have the lowest rating of the four groups on achievement variable with (12 competences having lower score) and the lowest rating of the four groups with (9 competences having a lower score) on importance variable.

CORRELATIONS AMONG GROUPS

IMPORTANCE

	Academics	Employers	Students	Graduates
Academics	1,0000			
Employers	0,6825	1,0000		
Students	0,8555	0,7263	1,0000	
Graduates	0,9181	0,6539	0,8393	1,0000

ACHIEVEMENT

	Academics	Employers	Students	Graduates
Academics	1,0000			
Employers	0,7479	1,0000		
Students	0,8467	0,7726	1,0000	
Graduates	0,7447	0,4984	0,6803	1,0000

RANKING

	Academics	Employers	Students	Graduates
Academics	1,0000			
Employers	0,9339	1,0000		
Students	0,9533	0,9761	1,0000	
Graduates	0,9463	0,9477	0,9502	1,0000

Finally, correlation among the four groups is very high. As the ranking figure that shows that the lowest correlation is between academics and employers at 0.9339. Correlation reaches 0.9761 between employers and students. This high correlation among the four groups emphasises the validity of the developed list of competences.

4.6. Establishment of the List of Subject-specific Competences

4.6.1. *Questionnaire on Specific Disciplinary Competences for Applied Geology-Graduate level*

A questionnaire was used which presented a series of skill-related questions that could be of importance to career success. All questions were to be answered as that would be very helpful in improving the planning of student programmes. For each case, the choice made was to be circled. Each of the following skills listed were to be rated:

- The importance of each skill or aptitude for work in one's profession based on personal opinion.
- The level at which degree programmes at the university dealt with, develop each of these skills.

Free spaces were provided for addition of add skills that did not appear in the list but were considered to be important. The following scale was to be used 1 = none; 2 = weak; 3 = noticeable; 4 = high.

4.7. Level of importance to which a degree in university is developed

Skills that indicate the level of importance for the degree in Applied Geology were as follows:

1. Ability to apply earth science knowledge and techniques to design a mining engineering project.
2. Ability to find, characterise and estimate natural resources.
3. Ability to understand the origin and evolution of the earth and its components.
4. Ability to collect, map, analyse and interpret geological data using various geosciences techniques.
5. Ability to use methods and techniques of natural resources exploration and exploitation.
6. Ability to evaluate environmental impact of natural resources exploitation.
7. Ability to conduct geotechnical site investigation.
8. Ability to identify the genesis, types and uses of geological materials.
9. Ability to use and / or develop modern analytical and numerical techniques in geological solving problems.
10. Ability to evaluate the socio-economic impacts of geological resources and their utilisation.
11. Ability to monitor, assess and plan risk mitigation management in case of Geohazards.
12. Ability to implement health and safety legislation in geological resources exploitation.

13. Ability to use geological projects for sustainable development.

14. Perceiving and understanding the time-space dimension of geological processes and their effects on the planet.

15. Ability to contribute with the knowledge on georesources for engineering projects.

16. Ability to demonstrate knowledgeable geoscientific expertise in entrepreneurial and managerial skills.

17. Ability to carry outfield geological and laboratory investigations based on geoscientific standard procedures and code of practice.

Five most important skills were to be ranked and number for the ranking entered in the corresponding box, first indicating the most important skill, then the second in descending order of importance, and so on.

4.8. Specific Disciplinary Skills for Environment Geology Geosciences

1. Ability to apply earth science knowledge and techniques to design a mining engineering project.

2. Ability to find, characterise and estimate natural resources.

3. Ability to understand the origin and evolution of the earth and its components.

4. Ability to collect, map, analyse and interpret geological data using various geosciences techniques.

5. Ability to use methods and techniques of natural resources exploration and exploitation.

6. Ability to evaluate environmental impact of natural resources exploitation.

7. Ability to conduct geotechnical site investigation.

8. Ability to identify the genesis, types and uses of geological materials.

9. Ability to use and / or develop modern analytical and numerical techniques in geological solving problems.

10. Ability to evaluate the socio-economic impacts of geological resources and their utilisation.

11. Ability to monitor, assess and plan risk mitigation management in case of Geohazards.

12. Ability to implement health and safety legislation in geological resources exploitation.

13. Ability to use geological projects for sustainable development.

14. Perceiving and understanding the time-space dimension of geological processes and their effects on the planet.

15. Ability to contribute with the knowledge on georesources for engineering projects.

16. Ability to demonstrate knowledgeable geoscientific expertise in entrepreneurial and managerial skills.

17. Ability to carry outfield geological and laboratory investigations based on geoscientific standard procedures and code of practice.

Each participant was to consult four groups of people for the subject area to which the participant had expertise. The groups to be targeted were:

1. Graduates who had satisfactorily attended and completed a full curriculum / degree programme offered at a university.

    - The graduates chosen were to have graduated between three and five years earlier.

    - If there were few graduates each year, then the study was to capture graduates from the previous five years.

    - However, if there were many, then the consultation was to be limited to graduates of the last three years.

2. Employers or organisations that employ university graduated or diploma holders without being their current company managers.

3. Academic in subject area of the participant. If the department for the participant had a very small population to be sampled then university students in the other institutions in the country were to be sought for.

4. Students in the last two years of a degree programme at university or who had completed their studies and expected to receive a degree.

The sample sizes consulted for each group were to be 30 for the purpose of filling the questionnaire used.

4.9. Conclusion

It appears from the consultation survey done in the Applied Geology SAG that for Academics and Students the trend and the raking are always similar.

Graduate group and employers group have peculiar trend that is related to the challenge they face in the practice and application of various aspects of applied Geology.

For every stakeholder, the achievement variable always ranks between 2.4 and 3 while the importance variable does between 2.9 and 3.6.

Most generic competences are rated over 3.0, which is a strong indication that competences generated in Tuning Africa Phase I were very appropriate also for Applied Geology in Tuning Africa Phase II on importance variable.

Academics and /or students have the lowest rating of the four groups on achievement variable, with 12 competences having lower score.

On importance variable, graduates group have the lowest rating of the four groups, with 15 competences got having a lower score.

Subect-specific competences are rated also over 3.0, which is a strong indication that competences generated on importance variable are line with the stakeholder's views.

On the achievement variable except for competence 9 and 11 for students group, all competences are rated over 2.5 for the same reasons.

Correlation among the four groups is very high because the ranking figure shows that the lowest correlation is between academics and employers at 0.9339. Correlation reaches 0.9761 between employers and students. This high correlation among the four groups emphasises the validity of the developed list of competences.

Chapter 5

Meta-profile

Hassen Shube Sheko, Bernard Kipsang Rop and Digne Edmond Rwabuhungu

5.1. Introduction

González (2012) defines a meta-profile as: "A group representation of the structure and combination of competences which gives identity to a thematic area". She further states that meta-profiles "are referential elements and they are always mental construction destined to reflect and analyse possible classification behind the reference point". A Meta-profile is a way of representing the structure and combination of competences that give identity to the subject area and it is a mental construct that categorises competences into major recognised groups of components and illustrates their interrelationship. Meta-profiles present a tool not only for understanding the core elements and describing them, but also for their identification and explanation in a readily understood and shared language. They offer an image of the location, importance and weight of the different factors that must be considered in designing a degree programme.

5.2. Elaboration of a Meta-profile for the Subject Area

The Applied Geology Subject Area Group carried out the consultation process and analysed the results and selected the competences that learners must acquire in order to be awarded a degree in Applied Geology. After debating on the core elements and specialised aspects of the different areas, the participants collectively agreed on the core

constituents of competences. They then analysed the classification, structure and desired weight attached to each reference point (generic and subject-specific competences), discussed grouping of references, linkages and comparative importance for the references and ultimately developed meta-profiles. The SAG, after agreeing on the lists of components that identify the core and level of diversification, followed the next step of classifying the findings and creating a structure that communicates how they understand the relationships of components to each other.

An advantage of developing meta-profiles is that it facilitates the development of joint degrees. Through the consideration of the meta-profile, a degree profile's main elements may be identified and responsibilities for its construction be shared, based on a common understanding of the whole area. In this age of transnational degrees, tools that foster common understanding are particularly helpful.

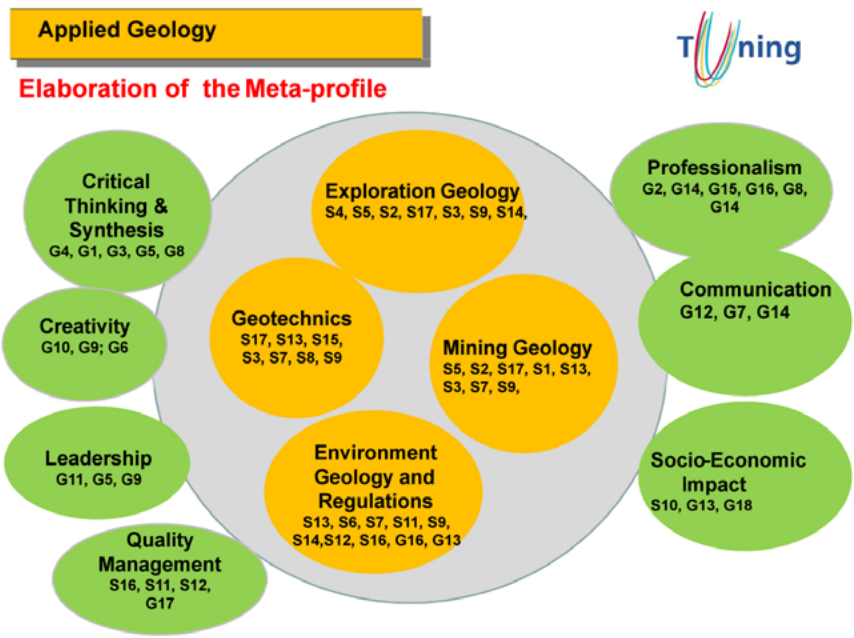


Figure 5.1
Applied Geology Meta-profile

The Applied Geology participants used an agreed terminology (S = specific and G = generic) competences to elaborate the meta-profile based on the subject-specific competences for the inner four circles, filled them with top five subject-specific competences first, and then continued adding the other competences, judged less important, before finally adding the generic competences. They then created other circles outside the core circles for Environmental Geology and Regulations. The SAG members explained the main components/ elements of the meta-profile and how it is linked to the previous steps (the agreed generic and subject-specific competences). The Meta-profile was presented in graphic form whereby the subject-specific meta-profiles are represented in the four central yellow circles, while the green circles surrounding the big circle show the generic profiles linked with the specific competences as per their relationships and relevance.

Competences were then linked in detail as shown in Figure 5.2.

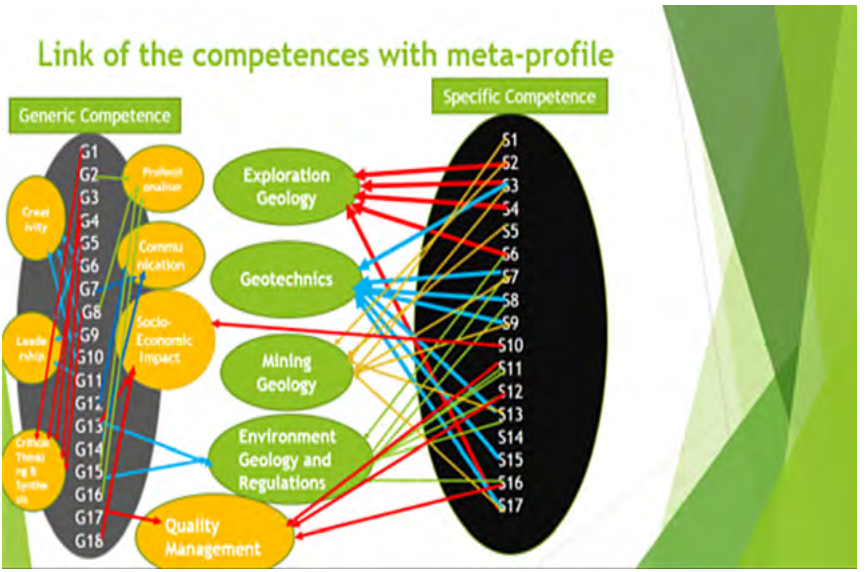


Figure: 5.2
Meta-profile and its link with competences

5.3. Subject-specific Competences

In the elaboration of the Meta-profile and based on academic experiences of the group members' four core skills were identified:

1. Exploration Geology comprises the S2, S3, S4, S5, S9, S17 and S14 subject-specific competences:

    - Ability to find, characterise and estimate natural resources.
    - Ability to understand the origin and the evolution of earth and its components.
    - Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques.
    - Ability to use methods and techniques of natural resources exploration and exploitation.
    - Ability to use and/or develop modern analytical and numerical techniques in geological solving problems.
    - Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice.
    - Perceiving and understanding the time-space dimension of geological processes and their effects on the planet.

2. The Geotechnics is using the S3, S7, S8, S9, S13, S15 and S17 subject-specific competences:

    - Ability to understand the origin and the evolution of earth and its components.
    - Ability to conduct geotechnical site investigation.
    - Ability to identify the genesis, types and uses of geological materials.
    - Ability to use and/or develop modern analytical and numerical techniques in geological solving problems.

- Ability to use geological projects for sustainable development.
- Ability to contribute with the knowledge on georesources for engineering projects.
- Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice.

3. The Mining Geology contains the S5, S2, S17, S1, S13, S3, S7 and S9 subject-specific competences:
   - Ability to use methods and techniques of natural resources exploration and exploitation.
   - Ability to find, characterise and estimate natural resources.
   - Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice.
   - Ability to apply earth sciences knowledge and techniques to design a mining engineering project.
   - Ability to use geological projects for sustainable development.
   - Ability to understand the origin and the evolution of earth and its components.
   - Ability to conduct geotechnical site investigation.
   - Ability to use and/or develop modern analytical and numerical techniques in solving geological problems.
4. The Environmental Geology and Regulations include S13, S6, S7, S11, S9, S14, S12 and S16 subject-specific and the G16 and G13 generic competences:
   - Ability to use geological projects for sustainable development.
   - Ability to evaluate environmental impact of natural resources exploitation.

- Ability to conduct geotechnical site investigation.
- Ability to monitor, assess and plan risk mitigation management in case of Geohazards.
- Ability to use and/or develop modern analytical and numerical techniques in geological solving problems.
- Perceiving and understanding the time-space dimension of geological processes and their effects on the planet.
- Ability to implement health and safety legislation in geological resources exploitation.
- Ability to demonstrate knowledgeable geoscientific expertise in entrepreneurial and managerial skills.
- Evaluate, review and enhance quality.
- Environmental and economic consciousness.

5.4. Generic Competences

Generic competences identified were also grouped to address additional skills need.

5. The Professionals is using the G2, G4, G15, G16, G8 and G14 generic competences:
   - Professionalism, ethical values and commitment to UBUNTU.
   - Ability to translate knowledge into practice.
   - Ability to work independently.
   - Ability to evaluate, review and enhance quality.
   - Ability to learn to learn and capacity for lifelong learning.
   - Ability to work in an intra- and intercultural and/or international context.

6. The Communication skills target need is using the G12, G7 and G14 generic competences:

   - Communication and interpersonal skills.
   - Ability to communicate effectively in official /national and local languages.
   - Ability to work in an intra- and intercultural and/or international context.

7. The Socio-economic Impact is using S10, G13 and G18 generic and specific competences:

   - Ability to evaluate socio-economic impacts of geological resources and their utilisation.
   - Environmental and economic consciousness.
   - Commitment to preserve African identity and cultural heritage.

8. The Quality Management is using the S16, S11, S12 and G17 specific and generic competences:

   - Ability to demonstrate knowledgeable geoscientific expertise in entrepreneurial and managerial skills.
   - Ability to monitor, assess and plan risk mitigation management in case of Geohazards.
   - Ability to implement health and safety legislation in geological resources exploitation.
   - Self-confidence, entrepreneurial spirit and skills.

9. The Leadership is using the G11, G5 and G9 generic competences:

   - Leadership, management and teamwork skills.
   - Objective decision making and practical cost-effective problem solving.
   - Flexibility, adaptability and ability to anticipate and respond to new situations.

10. Creativity is using the G3, G10, G9 and G6 generic competences:

    - Capacity for critical evaluation and self-awareness.
    - Ability for creative and innovative thinking.
    - Flexibility, adaptability and ability to anticipate and respond to new situations.
    - Capacity to use innovative and appropriate technologies.

11. The Critical Thinking and Synthetics is using the G4, G1, G3, G5 and G8 generic competences:

    - Ability to translate knowledge into practice.
    - Ability for conceptual thinking, analysis and synthesis.
    - Capacity for critical evaluation and self-awareness.
    - Objective decision making and practical cost-effective problem solving.
    - Ability to learn to learn and capacity for lifelong learning.

5.5. Conclusion

In conclusion, the Meta-profile in Applied Geology emerges from the subject-specific competences and generic competences core groups. Since a meta-profile is used to explain the relationship between generic and subject-specific competences and give reference to the particular subject area regarding what is central, common and necessary in order to recognise a given qualification (Knight and Woldegiorgis, 2017). It also constitutes the tool that certainly helps students to learn also by training that of course needed some adjustment on initial competences during the education process as started by Heijke (2003). The group adopted the following domains in the Applied Geology Meta-profile: **the Exploration Geology, the Mining Geology, the Geotechnics and the Environmental Geology and Regulations.** It covers all Applied Geology aspects for BSc degree programme and constitutes the core of the Meta-profile designed by the SAG.

Chapter 6

The Applied Geology Meta-profile and Opportunities

Bernard Kipsang Rop and Digne Edmond Rwabuhungu

6.1. Introduction

The Bachelor of Science in Applied Geology four-year degree programme blends a thorough knowledge of geological principles with practical emphasis on the earth's resources. It is intended to provide adequate theoretical concepts and practical skills that are required in both geological and construction-based environments for the enhancement of infrastructural development in both the public and private sectors of the mining and construction industries.

Other focus areas are on mineral and ground water resources. A unique component of the programme is environmental management to advocate for the proper use of the earth's resources in a sustainable manner.

Geologists seek to advance their knowledge about how the dynamic earth system works and correlate it to the effects it has on mankind and vice-versa. Environmental protection, geological hazards, variability of resources and climate change are of key interest to geologists.

The objective of the degree programme is to produce graduates with adequate knowledge which they can use in practice in order to meet the demand in industry. The students are trained to become geologists who are career-ready professionals; who through their knowledge of

geology can actively contribute to the development of the mining and/or construction industry.

Emphasis is on equipping students with basic foundational knowledge in sciences (i.e. physics, chemistry, introduction to geology and mathematics) during the first year; whereas geological processes are explored in the second year through theory, laboratory and field work skills. A comprehensive coverage of all the core disciplines of Applied Geology in the meta-profile is achieved in the third and final years of the programme.

6.2. Career Opportunities

Geologists are necessary for the extraction and management of vital resources. Some of the various roles that Geologists are involved in include advisory provision on:

- Site Investigations for Construction Projects (i.e. roads, dams and bridges).
- Groundwater.
- Minerals.
- Petroleum.
- Investigation of natural hazards (volcanic eruptions, landslides, earthquakes, etc.).

Table 6.1
Some of the job outcomes for the qualified Geologist are as follows

• Engineering Geologist • Geoscientist • Environmental Geologist • Geomorphologist • Mine Site Geologist • Hydrogeologist • Exploration Geologist	• Database Geologist • Petroleum Geologist • Structural Geologist • Paleontologist • Mineralogist • Stratigrapher /Sedimentologist • Mathematical Geologist

SPECIFIC				
	academics	Employers	Students	Graduates
TOP	Rank	Rank	Rank	Rank
	1	5	4	4
	4	4	2	17
	5	13	1	1
	17	2	17	2
	2	1	5	5
MIDDLE	6	12	13	10
	11	17	6	6
	10	10	7	12
	9	15	9	15
	13	11	12	9
	15	8	11	3
	8	6	15	8
BOTTOM				
	3	3	3	11
	7	7	8	7
	12	16	10	13
	16	9	16	16
	14	14	14	14

Figure 6.1
Subject-specific Competences priorities of stakeholders

	specific competences
01S04	4. Ability to collect, map, analyse and interpret geological data using various Geoscientific techniques
02S01	1. Ability to apply earth sciences knowledge and techniques to design a mining engineering project
03S05	5. Ability to use methods and techniques of natural resources exploration and exploitation
04S02	2. Ability to find, characterise and estimate natural resources
05S17	17.Ability to carry out field geological and laboratory investigations based on geoscientific standard procedures and code of practice
06S13	13.Ability to use geological projects for sustainable development
07S06	6. Ability to evaluate environmental impact of natural resources exploitation
08S15	15.Ability to contribute with the knowledge on georesources for engineering projects
09S03	3. Ability to understand the origin and the evolution of earth and its components
10S07	7. Ability to conduct geotechnical site investigation
11S16	16.Ability to demonstrate knowledgeable geoscientific expertize in entrepreneurial and managerial skills
12S11*	11.Ability to monitor, assess and plan risk mitigation management in case of Geohazards
13S08	8. Ability to identify the genesis, types and uses of geological materials
14S12	12.Ability to implement health and safety legislation in geological resources exploitation
15S10	10.Ability to evaluate socio-economic impacts of geological resources and their utilisation
16S09	9. Ability to use and/or develop modern analytical and numerical techniques in geological solving problems
17S14	14.Perceiving and understanding the time-space dimension of geological processes and their effects on the planet
* : GAPS	

Figure 6.1
(cont.)

From the discussion on consultation on generic competences in chapter 4, correlation was also done for the subject-specific competences. It clear appears that the classification done by the SAG and the 5 top rank priorities on subject-specific competences in the view of main stakeholders consult is slightly different.

Figure 6.1 shows the Subject-specific Competences priorities of stakeholders.

6.3. Conclusion

The Tuning Methodology followed by the Applied Geology SAG aims to provide a harmonised and comprehensive bachelor degree programme. The BSc offers a wide range of carrier opportunities that inevitably *are linked* to the competences acquired in the higher education process. The designs of the Meta-profile and of the design of the carrier are therefore necessary in correlation. In the design of the Applied Geology BSc degree programme, the 4 core parts are linked to main carrier opportunities.

Chapter 7

Examples of Revised/New Programme

Mouloud Nefis, Alsharef Albaghdady,
Bernard Kipsang Rop and Digne Edmond Rwabuhungu

7.1. Introduction

Following the **design process** and the consultation done at the SAG of Applied Geology, the participant universities decided to establish a new programme or to revise an existing degree programme in geology. For this publication, the group has decided to present two programmes: A Bachelor of Science in Applied Geology put in place at the Geology Department of Sebha University in Libya and a Bachelor of Science in Applied Geology at Jomo Kenyatta University of Agriculture and Technology, in Kenya. These two examples from two continental sub-regions stand to show that students and graduate mobility is possible.

7.2. Geology Department of Sebha University, Libya

7.2.1. *Name of the New Programme*

Bachelor of Science in Applied Geology.

7.2.2. *Generic and/or Subject-specific Competences*

The graduates awarded a BSc. in the Applied Geology programme at Sebha University are expected to gain the necessary knowledge and achieve the generic and subject-specific competences as described above in sections 5.2 and 5.3.

7.2.3. *Length and Level of the Programme*

The BSc. in Applied Geology is a four-year programme.

The programme is intended produce graduates who will qualify to pursue MSc. and/or PhD degree programmes in any geological disciplines as a result of the knowledge and competences acquired during their course of study.

7.2.4. *Occupation of Graduates*

Occupations of the graduates are:

- Geological Mapping.
- Field data collection and data analysis.
- Management of Water Resources.
- Drilling Supervision.
- Geological Exploration.
- Mineral Exploitation.
- Mineral Processing.
- Mining Management.
- Monitoring, evaluation and planning.
- Research, training, teaching and innovation.

- Geosciences.
- Engineering and construction companies.
- Museums.

Generic and Subject-specific competences as defined in this book.

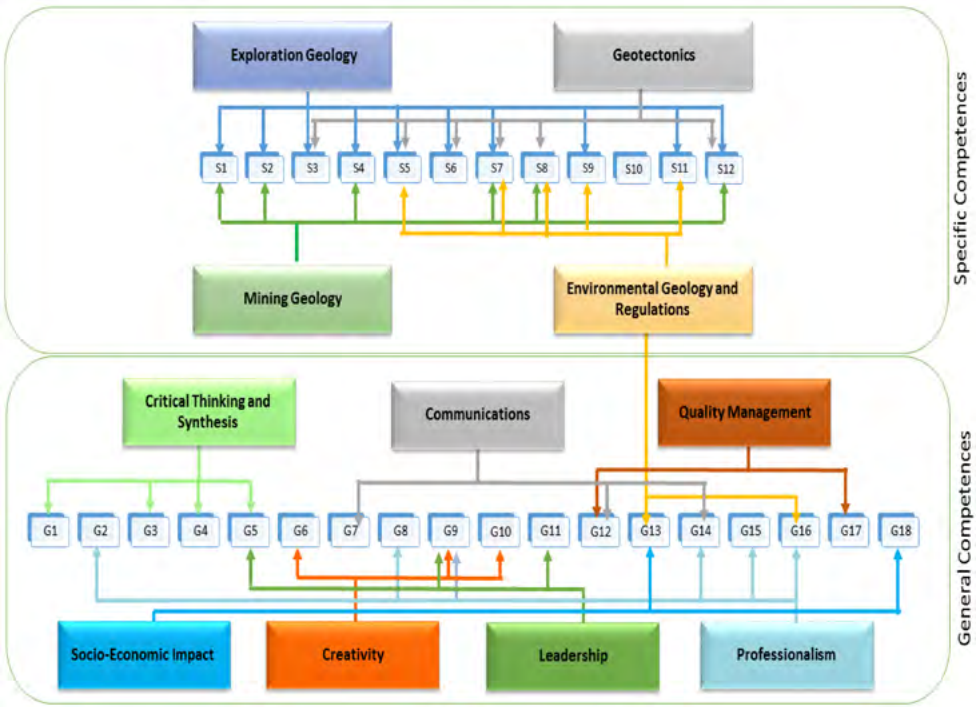


Figure 7.1
Flow chart for specialties

7.2.5. *Specification of the Level of the Competences*

The level of the competence will be reached if the students achieve 50% of the learning outcomes.

7.2.6. *Description of the Expected Learning Outcomes*

1. To be familiar —in depth— with the earth origin, layering (atmosphere, hydrosphere, biosphere, and lithosphere), history, and geological time scale as a pixel within a bigger picture of our solar system, milky way, and universe.

2. Understand the principles of geological formations and structural deformation and their spatial and temporal distribution at surface and subsurface conditions.

3. Be familiar with the conceptions of different geological subjects like sedimentology, depositional environment and stratigraphy, well logging and formation evaluation, paleontology and earth history, hard rock petrology and economic mineralogy, geophysics and remote sensing.

4. Based on classroom lectures and exercises, the student should be able to evaluate the sedimentary basins with regard to petroleum systems, hydrocarbon occurrence, management of hydrological resources, and mining of prospective ore deposits.

5. Ability to use the classroom fundamentals of geology as a key to decipher any geological problems at the field, and to be able to conduct different surface and subsurface geological surveys successfully.

6. To be able to use laboratory and field equipment to conduct an efficacious geological research~~es~~ and then to present that work in the form of proper written reports, journal articles, verbal presentations, posters, and online publications.

7. Ability to work in a team and know communication skills.

7.2.7. *Learning Strategy for Achieving the Competences*

The methodology of learning strategy will be based on:

- Lecture exercises.
- Discussions and exercises.
- Laboratory work.

- Supportive courses.
- Field trips are essential elements of the programme.
- Scientific language.
- Seminars and Final Project.

7.2.8. *Specification of the Course Units Comprised in the Programme*

N	Semester	Course	Code	Teach. H.	Lab H.	Credit
1	1	Physical Geology	GEO1000	2	0	2
2		Crystallography and mineral optics	GEO1001	2	3	3
3		Historical Geology	GEO1002	2	3	4
4	2	Into. Sedimentology	GEO2000	2	3	3
5		Mineralogy	GEO2001	2	3	4
6		Paleontology	GEO2002	2	3	3
7	3	Depositional Environment	GEO3000	2	3	3
8		Igneous Petrology	GEO3001	2	3	3
9		Micropalaeontology	GEO3002	2	3	3
10		Structural Geology	GEO3003	2	3	3
11		Environmental Geochemistry	GEO3004	2	3	3
12	4	Stratigraphy	GEO4000	2	3	3
13		Metamorphic Petrology	GEO4001	2	3	3
14		Hydrogeology	GEO4002	2	3	3
15		Geological Mapping	GEO4003	2	3	3
16	5	Geophysics	GEO5000	2	3	3
17		Geochemistry	GEO5001	2	3	4
18		Subsurface Methods	GEO5002	2	3	4
19		Remote Sensing	GEO5003	2	3	3

N	Semester	Course	Code	Teach. H.	Lab H.	Credit
20		Geowriting	GEO5004	2	0	2
21	6	Basin Analysis	GEO6000	2	3	3
22		Ore Deposits	GEO6001	2	3	3
23		Geostatistics	GEO6002	2	3	3
24		Field Geology	GEO6003	2	field	4
25		Seismic Interpretation	GEO6004	2	3	3
26	7	Sedimentary Basin Analysis	GEO7000	0	0	1
27		Geotectonics	GEO7001	2	3	3
28		Geological Engineering	GEO7002	2	3	3
29		Seminar	GEO7003	2	3	3
30	8	Sequence Stratigraphy	GEO8000	2	3	3
		Geology of Libya	GEO8001	2	3	3
31		Petroleum System	GEO8002	2	3	3
32		Project	GEO8003	0	0	4
Elective Courses						
1	3	Soil	GEO3006	2	3	3
2		Clay Mineralogy	GEO3007	2	3	3
3	5	Carbonate Sequence Stratigraphy	GEO5006	2	3	3
4		Advanced Petrology	GEO5007	2	3	3
5	6	Groundwater Modeling	GEO6006	2	3	3
6		Reservoir Characterisation	GEO6007	2	3	3
7		Isotope Geology	GEO6008	2	3	3

7.2.9. *Evaluation Strategy for Achieving the Competences*

The learning outcome to be achieved through the above-mentioned methodology will be evaluated through oral and written examinations,

lab and field problem-solving and evaluation of written reports. The programme courses will be assessed as follows:

- Courses with 3 credits: Midterm exam (20%), lab work and reports (20%), Activities like reports and homework (10%), and final exam (50%).
- Geowriting with 2 credits: Class work and activities (60%), and Final report (40%).
- Field work with 4 credits: Field student assessment in knowledge, discussion, scientific arguments, field techniques, and group work (60%) and Final report (40%).
- Final project with 4 credits: Presentation and defense (60%), Final written project (40%).

7.2.10. *Coherence of the Programme with the Required Competence Set*

The programme has been structured in a manner such that all the learning outcomes are achieved. There is a direct relationship between the units outlined in the programme and the corresponding learning outcomes. The desired level of quality demands consistency in the delivery of the programme; therefore, reports and questionnaires will be used as evaluation tools that will allow the evaluation of the programme.

7.3. Jomo Kenyatta University of Agriculture and Technology

7.3.1. *Bachelor of Science in Applied Geology*

The new degree programme leads to the award of a BSc. in Applied Geology. This programme, offered at the undergraduate level, seeks to form graduates able to apply geological knowledge in different fields, and especially to infrastructure development projects.

7.3.2. *Introduction to the Course*

The Bachelor of Science in Applied Geology programme will be the first of its kind in a Kenyan university and will be primarily offered by Jomo Kenyatta University of Agriculture and Technology (JKUAT). This programme blends a thorough knowledge of geological principles with practical emphasis on the earth's resources. It is intended to provide adequate theoretical concepts and practical skills that are required in both geological and construction-based environments for the enhancement of infrastructural development in both public and private sectors of the construction industry.

Other focus areas are on mineral and ground water resources. A unique component of the programme is environmental management to advocate for proper use of the earth's resources in a sustainable manner.

Geologists seek to advance their knowledge of how the earth works and correlate it to the effect it has on mankind and vice versa. Environmental protection, geological hazards, variability of resources and climate change are of key interest to geologists.

The objective of the course is to produce graduates with adequate knowledge which they can use in practice in order to meet the demand in industry. The students are trained to become geologists who are career-ready professionals; who through their knowledge of geology can actively contribute to the development of the construction industry.

The four-year programme is designed and structured to equip students with basic foundational knowledge in sciences i.e. physics, chemistry, introduction to geology and mathematics during the first year.

Geological processes are emphasised in the second year through theory, laboratory and field work skills. A comprehensive coverage of all the disciplines of applied geology is achieved in the third and final years of the programme which will culminate in the completion of supervised projects.

7.3.3. *Career Opportunities*

Kenya is experiencing the biggest construction boom with multi-billion shilling infrastructure projects poised to fuel the country's economic growth. There are many openings for geologists in the construction industry and graduate geologists are likely to be absorbed in large numbers.

Recent oil and mineral resource discoveries in Kenya have led to an increase in demand for geologists who will work in the sector. Geologists are essential in the extraction and management of these vital resources. Some of the various roles that Geologists are involved in include advisory provision on:

- Construction Projects i.e. roads, dams and bridges.
- Groundwater.
- Minerals.
- Petroleum.
- Investigation of natural hazards (volcanic eruptions, landslides, earthquakes, etc.).

Some of the job outcomes for the qualified Geologist are as follows:

• Engineering Geologist	• Database Geologist
• Geoscientist	• Petroleum Geologist
• Environmental Geologist	• Structural Geologist
• Geomorphologist	• Paleontologist
• Mine Site Geologist	• Mineralogist
• Hydrogeologist	• Stratigrapher
• Exploration Geologist	• Mathematical Geologist

All the components of the meta-profile are included in the profile description. To a large extent, focus is placed more on the competences that are subject-specific and form the core of the meta-profile. The meta-profile of the new **BSc. Applied Geology** course is a reflection of the meta-profile developed by SAG on Applied Geology during the Tuning Africa II in Addis Ababa as shown in sections 5.2 and 5.3.

The key competences as set in the course profile are as follows:

1. Generic Competences:

   - Thinking independently.
   - Capacity to think logically, quantitatively and creatively.
   - Planning and organisational skills.
   - Leadership and Team work.
   - Ability to assess critically and synthesize data or literature.
   - Effective communication.
   - Ability to work in an intra or inter-cultural setting.
   - Professionalism and: strong adherence to ethical principle.

2. Subject-specific Competences.

   A. Knowledge and Understanding

   This is displayed by a learner who has developed a coherent and multi-disciplinary knowledge of Applied Geology i.e. mineral georesources, petroleum geosciences, and environmental geology among others. Such knowledge and understanding enables a learner to develop the:

   - Ability to find, characterise and estimate natural resources.
   - Ability to use knowledge of Earth Sciences to design mining engineering projects.
   - Ability to understand geological processes related to earth's natural resource formation and their exploitation by industry.
   - Ability to conduct geotechnical site investigation.
   - Apply geoscientific skills in managerial levels or entrepreneurship.

- Ability to collect, map, analyse and interpret geological data using various geoscientific techniques.
- Ability to evaluate environmental impacts in natural resource exploitation.
- Ability to evaluate socio-economic impacts of geological resources and their utilisation.

7.3.4. *Level of Achievement of the Competences*

Knowledge and understanding are normally gained gradually as a student becomes exposed to variables previously unknown to him/her. Understanding is reinforced with experience so that the more experienced you are, the more understanding you have of a specific subject matter.

The competences acquired by a student thus develop over time from the moment he or she is introduced to the Applied Geology course during the first semester of studies. At the beginning (the 1st and 2nd years of study), key generic competences such as effective communication, independent thinking, planning and organisation are stressed. With time, especially from the 3rd year and 4th year respectively, a student's level of competence is highly advanced. He/she is able to demonstrate good leadership and teamworks abilities make judgments or find solutions to an array of applied geological problems and also tend to be more professional.

7.3.5. *Learning Outcomes to be achieved*

At the end of the Applied Geology course, a graduate shall be able to demonstrate ability to:

1. Apply fundamental geo-scientific concepts and procedures when undertaking tasks that involve geology of excavations including dams, quarries, tunnels and construction sites for infrastructural development.
2. Acquire sound technical knowledge, creative skills and positive attitudes for engaging in construction projects on a participatory

level and as a resource for consultancy in the evolving construction industry.

3. Carry out petrological and laboratory investigations for geoscientific and construction purposes based on standard procedure and codes of practice that are in place.

4. Acquire geoscientific knowledge, entrepreneurial and managerial skills for mobilising natural resources by investing in private or public sector for income generation purposes.

5. Develop the capability to undertake research in both geoscientific and construction sectors for enhancement of infrastructural development.

6. Appreciate the important role of geoscientific knowledge in the successful performance of the construction industry, thereby fostering overall progress of the country's economy.

7. Develop a sound foundation for pursuing higher courses having acquired geoscientific knowledge supported by construction concepts at bachelor's degree level.

8. Solve geological problems using logical scientific methods and creative thinking.

9. Communicate geological information concisely and accurately using written, visual, and verbal means appropriate to the situation.

10. Actively apply information technology in the practice of Applied Geology.

11. Appreciate the need for sustainable development of the environment in the practice of Applied Geology and the importance of responsible, personal, social and cultural interrelationships.

12. Value the importance of ethics and the need for professionalism in the practice of Geology as well as upholding the interests of clients, the profession and society.

7.3.6. *Learning Methodology*

Active Learning in the Classroom

This method seeks to engage students in a class. Active participation by students is anchored on three domains which are knowledge, skills and attitudes. The course encourages students to be involved through writing, reading, discussing and solving problems.

The classroom will be a good environment for problem-based learning where problems will be presented for discussion and where the reactions to them can be gathered.

Individual Assignment

Independent thinking, planning and organisation are encouraged through individual assignments in the classroom. As an individual, one is responsible for one's work. Evaluation is important in order for the lecturer to identify the strengths and the weaknesses of each of the students. Thus, the lecturer will be able to revisit areas which were unclear to the students thereby increasing their understanding and confidence.

Group Work Assignment

Although group work assignments are best completed outside the classroom, some group work assignments conducted in class are usually fun and students tend to remember what was discussed during the group work in class.

Leadership and teamwork are competences which can be formed by engaging in group assignments. High levels of understanding are achieved through such activities when the results of the assignment are subjected to peer review.

Project-based Learning

Project-based learning is powerful and engages many faculties since it is conducted usually over an extended period of time. The assignments

are meant to respond to an authentic, complex question or problem. Hence, project-based learning will promote the ability to analyse and synthesize data. It will also foster independent thinking and ability to work in a team when students undertake group assignments.

Experimental Learning - Field and Laboratory Activities

Practical skills and competences are critical to student engagement and effective learning. The main focus of laboratory exercises in Applied Geology will be on the development of basic, practical skills, competences and knowledge of experimental techniques. The practical approach will be 'hands on" and the exercises will be derived from the disciplines included in the relevant specialties. Lecturers, assisted by laboratory technicians, are tasked with the responsibility of ensuring that the practical exercises are properly carried out until the required competence is achieved.

Practical Trips

Practical trips are a vital component in knowledge acquisition. The trips provide the opportunity for students to appreciate what is learnt in the classroom. The trips also enhance students' knowledge as they understand more of the content which was taught in class. Assessment of knowledge can be achieved by means of trip reports produced by the students. A lecturer should also develop pointers or questions which the students can use as guides in the process of knowledge acquisition during the practical trip.

The practical trips should link learning, motivation, innovation and teaching needs for the learners. They will also provide an opportunity for the learners to acquire practical competences for future application.

Attachment Learning

Another critical learning avenue is through 'attachment' in industry. This is especially important for students to get the needed exposure to real-life professional work. The course fosters the attainment of such knowledge through external attachment, enabling learners to develop Employer Related Skills and Competences (ERSC).

During the attachment, usually lasting 8 weeks, the students are required to write down a daily record of the tasks they perform. Reports are written on a weekly basis. This provides a good picture of all the levels of learning and can easily be used to test knowledge and understanding of the student. The employer has to review and approve the reports in the log book to ensure that high standards are maintained and areas of weaknesses are noted and improved upon.

Research

Every student especially in the final year of study is required to conduct a research project in any of the disciplines of Applied Geology. This allows a student to further his/her interest in a particular topic and make a contribution to previous research including that conducted by others.

Data collection, entry and analysis are central to this process. A final year student who has been developing both generic and subject-specific competences is presented with an opportunity to use the competences formed over the years of study to produce a good research project. The course units pertaining to the programme are distributed as follows:

7.3.7. *Applied Geology Programme – An Overview of the Course Units*

The units are detailed as below:

Year	Semester	Unit Code	Unit Name
1	I	BMC 2107	Communication Skills
		BAC 2142	Development Studies
		APH 2100	HIV/ AIDS and Substance Abuse
		AMA 2101	Mathematics for Geoscientists I
		EIT 2101	Introduction to Computer science
		APS 2101	Physics I
		ACH 2101	Inorganic Chemistry
		GEO 2101	Geomorphology
	II	BEN 2208	Entrepreneurship Education
		AMA 2102	Mathematics for Geoscientists II
		EIT 2102	Computer Applications
		APS 2102	Physics II
		ACH 2102	Organic Chemistry
		GEO 2102	Mineralogy and Optical Microscopy
		GEO 2103	Paleontology
		GEO 2104	Sedimentary Petrology
2	I	BEN 2230	Business Plan
		AMA 2201	Mathematics for Geoscientists III
		ACH 2201	Fundamentals of Physical Chemistry
		ECV 2201	Fluid Mechanics
		GEO 2201	Practical Mineralogy and Optical Microscopy
		GEO 2202	Field Geology and Report Writing
		GEO 2203	Practical Paleontology
		GEO 2204	Practical Sedimentary Petrology
	II	AMA 2202	Mathematics for Geoscientists IV
		GEO 2205	Fundamentals of Geochemistry
		GEO 2206	Fundamentals of Geophysics
		GEO 2207	Photogeology and Remote Sensing
		GEO 2208	Structural Geology
		GEO 2209	Stratigraphy
		GEO 2210	Igneous Petrology
		GEO 2211	Mapping Sedimentary Terrain

Year	Semester	Unit Code	Unit Name
3	I	AMA 2301	Numerical Analysis
		GEO 2301	Geospatial Information Systems (GIS)
		GEO 2302	Economic Geology
		GEO 2303	Fundamentals of Soil Mechanics
		GEO 2304	Practical Structural Geology
		GEO 2305	Metamorphic Petrology
		GEO 2306	Practical Igneous Petrology
		ECV 2301	Construction Materials I
	II	AMA 2302	Statistics and Probability for Geoscientists I
		BEN 2301	Research Methodology
		GEO 2307	Fundamentals of Hydrogeology
		GEO 2308	Fundamentals of Rock Mechanics
		GEO 2309	Geological Maps
		GEO 2310	Practical Metamorphic Petrology
		GEO 2311	Mapping Igneous Terrain
		ECV 2302	Construction Materials II
	III	GEO 2312	Attachment (External)
4	I	AMA 2401	Statistics and Probability for Geoscientists II
		ECV 2401	Mechanical Plant and Equipment
		GEO 2401	Geological Developments and Seminars
		GEO 2402	Fundamentals of Engineering Geology
		GEO 2403	Mining Geology
		GEO 2404	Fundamentals of Seismology
		GEO 2405	Mapping Metamorphic Terrain
		GEO 2406	Project (2 Units)
	II	GEO 2407	Global Tectonics
		GEO 2408	Geology and Mineral Resources of Kenya
		GEO 2409	Phanerozoic Geology
		GEO 2410	Fundamentals of Marine Geology
		GEO 2411	Natural Resources Management
		GEO 2412	Environmental Impact Assessment

7.3.8. *Conclusion*

There is consistency between the programme and the competences that the programme intends to achieve.

The learning outcomes specified in the course content are congruent with the competences outlined.They focus on the earth origin, layering (atmosphere, hydrosphere, biosphere, and lithosphere), history, and geological time scale as a pixel within a bigger picture of our solar system, Milky Way, and universe and also on principles of geological formations.Structural deformation and their spatial and temporal distribution at surface and subsurface conditions are also important. At the end, graduate will be able to use laboratory and field equipment to conduct an efficacious geological researches and then to present that work in the form of proper written reports, journal articles, verbal presentations, posters, and online publications and to work in a team with good communication skills.

Critical thinking and learning achieved/pursued through industrial attachment. This is especially important for students to get the needed exposure to real-life professional work that fosters the attainment of such knowledge, thus enabling learners to develop skills and competences required by in the labour market.

Overall, it can be stated that there is consistency between the programme, learning outcomes and competences since links and contrast were addressed accordingly.

Chapter 8

Reflections on Student Workload

Ayonma Wilfred Mode, Ahmed Ousmane Bagre and Digne Edmond Rwabuhungu

8.1. Introduction

The Applied Geology SAG conducted a student workload survey to estimate the real hours of work needed to pass a unit/course/module from the point of view of academics and students of the subject area. The survey was conducted among students from the fifth semester of studies in each of the universities participating in the SAG. All the academics who taught any course in the chosen semester were surveyed. Twelve students who had passed each of the units/courses/modules in the selected semester were also surveyed. In the cases where number of students who passed the relevant units/courses/module was lower than twelve, the students surveyed were the actual number of students. For each unit/course/module in the concerned semester,the survey (conducted) involved one academic staff and at least 12 students who have passed that unit/course/module.

8.2. Results and Reflections

The survey covered both independent work and contact hours. Contact hours are the amount of time spent in direct contact with the teacher or other staff of the university during a particular unit/course/module (they include the time spent in lectures, seminars, laboratory work, project work and field work). Independent work is the time spent to study the unit/ course/module by the student working on his or her own apart from the contact hours.

The student's independent works include reading texts or literature, fieldwork (site visits, etc., not supervised), laboratory work (not supervised), preparation and execution or presentation of written work, working with internet sources and preparing for interim assessment, and final exam.The survey questions and the results of the survey are shown in Tables 8.1 and 8.2, as well as in Figures 8.1 and 8.2.

Table 8.1
Students Workload Survey for Applied Geology Subject Area Group

Survey Question	Academics	Students
Total contact hours foreseen for the semester	365.25	413.05
Total independent work needed to complete the necessary units/courses/modules	378.17	441.28
Total contact hours and independent work needed to complete successfully the necessary units/courses/modules during the semester	743.42	854.33
Number of hours an average student needs to complete all the requirements of the unit/course/module in the semester (taking into account both contact hours and Independent work)	515.42	585.23
How many hours per week do an average student do (taking into account contact hours and independent work)?	124.83	151.31

This survey result data indicate that students´ answers on every question are mostly overestimated as opposed to the academics´ estimations. Normally, academics analyse the survey data using estimated time for each activity; for example the exact amount of fieldwork that should be included in the semester. In all questions, students feel that they need more time for example for the preparation of assessments and exams or to complete all requirements of the unit.

The survey also indicates that, for Applied Geology, an approximately equal amount of time is needed for independent work and contact hours in a semester. In the opinion of academics the proportion of contact hours versus independent work is 49% to 51%; while in the opinion of students, it is 48% to 52%.

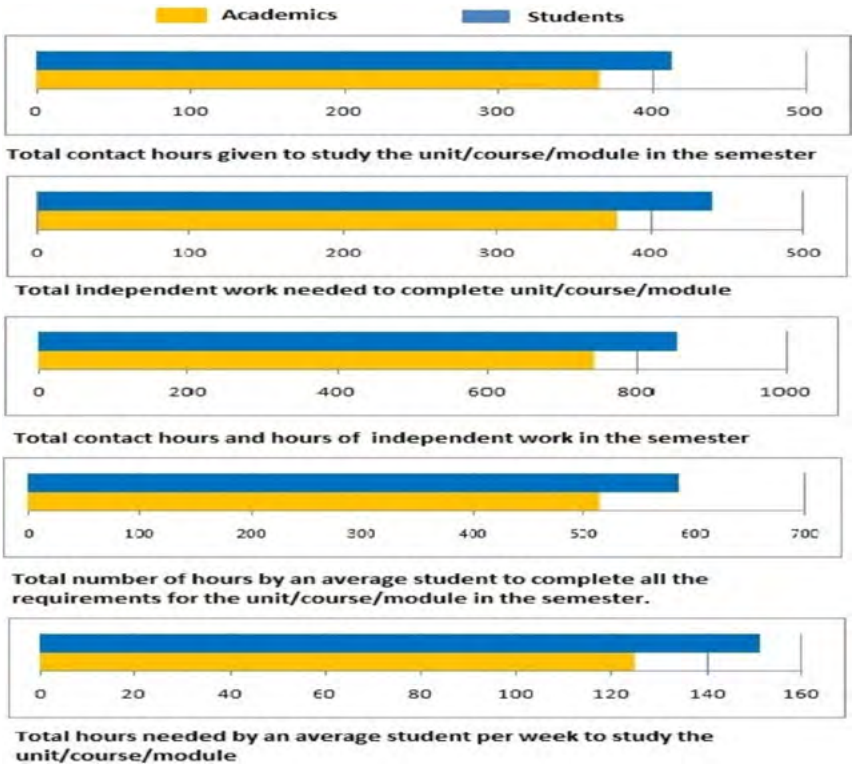


Figure 8.1
Survey Results

The nature of the Applied Geology course entails a lot of contact between the students and the staff during field work, laboratory work, tutorials and projects, etc. Thus, approximately equal amount of time is needed for contact hours and independent work.

The survey also shows that a very significant percentage of academics **(74.3%)** considered it necessary to include hours of independent work when planning the workload. However, only **46.89%** considered students' expectations and evaluations when planning workload. Less than **50%** of the students (**49.21%**) were aware of the hours planned for the students' independent work. Also at the beginning of the unit/course/module only **46.89%** of the students received guidance on the necessary workload for each part of the independent work.

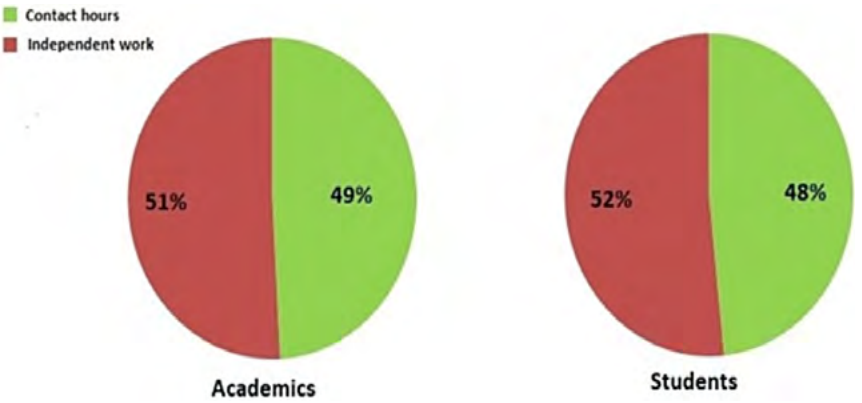


Figure 8.2
Contact hours Vs Independent work (%)

Table 8.2
Consideration of students' expectations during planning of workload/students' awareness of planned workload

Percentage of *academics* who agree with the statements:		Percentage of *students* who agree with the statements:	
When planning the workload for your unit/ course/ module you consider it necessary to include a certain number of hours for independent work.	When planning the workload for your unit/ course/ module, you take into account student's expectations and evaluation into consideration.	You are aware of the number of hours planned for students' independent work.	The professor gave you guidance at the beginning of the unit/course/ module on the workload necessary for each part of the independent work.
71.43%	46.89%	49.21%	25.65%

The above observations from the survey show that it is imperative for the hours for independent work and student expectations and evaluations to be considered when planning students' workload. Students should also be made aware of the number of hours planned for independent work; and at the beginning of the unit/course/module they should be guided on the necessary workload for each part of the independent work.

8.3. Conclusion

The workload on independent work and contact hours for Applied Geology degree programme needs to be 1 contact hour per 1 independent student´s work hour: it is a particular case. For many BSc degree programmes the ratio of 1 contact hour per 3 independent student´s hours of work is observed.

The Applied Geology field work and practice, which constitute the important part of the student independent work, need to be aligned with the concept of "competence-based learning" exposed by Lemaitre *et al*. (2006). It confirms that some topics do need appropriate preparation phase on professional skills and competences towards the ultimate goal.

Chapter 9

Conclusion

Louis Kipata and Digne Edmond Rwabuhungu

In the Tuning Africa II project, led by the International Tuning Academy, University of Deusto, Bilbao (Spain), the Applied Geology Subject Area Group (SAG) is made up by academics coming from 14 universities and from all sub-regions of the African continent and is coordinated by the Dean of the School of Mining and Geology at University of Rwanda. With its work, the SAG inevitably contributes fruitfully to the harmonisation of African higher education, generally recognised as a pressing need for the well being of the continent's peoples. Globally, the outcome of this SAG's work is not too far from the Tuning European SAG (on Earth Sciences) co-chaired by Ryan (2009) even if it is different to some extent.

The methodology followed focusses on the students and their need to develop the competences necessary for their professional, personal and civic future. The methodology emphasises the step-by-step process of setting goals, implementing appropriate changes, and monitoring the results so as to create positive change in current degree programmes or a solid basis for new ones. All the universities that participated in the Applied Geology SAG have either developed new programmes or revised existing ones according to the new criteria. This work will certainly be of immense benefit for creating equivalent degree programmes, facilitating student mobility and reciprocal understanding. The following issues / points could be considered as the main achievements of the Applied Geology SAG:

1. Relevant and workable lists of generic and subject-specific competences that meet international standards.

2. Harmonised competence-based Higher Education curricula focused on the application of concepts of Applied Geology.

3. A clear formulation of the concept "Applied Geology" itself, adapted to the African context as: "*The application of geological knowledge, principles and techniques in order to solve problems in exploration and exploitation of Natural resources, Geotechnics, Environmental protection and Geohazards*".

4. The Consultation done increases the conviction to strengthen the harmonisationof the Applied Geology degree programmes offered in Africa. The consultation survey done in the Applied Geology SAG reflects that for academics and students trend and ranking are always similar. But for graduates and employers, there is a particular trend that is specific in terms of challenges: employers' specific needs. Some graduates appear to be equipped with appropriate theory but with limited practical skills to satisfy the employer.

5. For every stakeholder, achievement variable is always ranked between 2.4 and 3 while importance variable is between 2.9 and 3.6.

6. The 17 specific competences identified are common to all Applied Geology components and are likely to be needed at the BSc degree level. However, the group decided to leave them open for future updates.

7. The elaboration of the Applied Geology Meta-profile with the 4 core sections: Exploration Geology, Mining Geology, Geotechnics and Environmental Geology and Regulation were identified.

8. The link between the core meta-profile section with all others generic and subject-specific competences established by the SAG.

9. All learning outcomes included in the design programme with most of the units related can be offered in all Africa sub-regions as shown by the two examples provided. We can easily state that there is consistency between the design programme, learning outcomes and competences that are linked within the elaborated Meta-profile.

10. The workload on independent work and contact hours for Applied Geology degree programme needs to be 1 contact hour per 1 student´s independent hour.

The Applied Geology SAG believes that, with the designed programmes, all the Africa sub-regions can easily bridge and harmonise degree programmes and facilitate student mobility by the incorporation of the meta-profile in curriculum processes across the continent.

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