Technology sciences

Vadyba
Journal of Management
2019, № 2 (35)
ISSN 1648-7974

INTEGRATION OF CLIMATE CHANGE AND ADAPTATION MANAGEMENT INTO LEARNING CURRICULUM IN HIGHER EDUCATION

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Abstract
Climate change issues are of a major importance in the modern world and these problems to be monitored and examined on the national level involving national organizations, business and industry, research institutions, including the different education levels. The aim of this study was to discover the stakeholders' need of the experts in the given area and to determine the major professional and general competences, knowledge and skills the future graduates should possess in order to be successful in their future career. The research of students and alumni was carried out in order to understand their current knowledge on the environment and climate change management. The principles for the enhancement of experiential learning in higher education suggest how experiential learning can be applied throughout the educational and development programs including curriculum development and experiences in knowledge of climate change processes and necessary adaptation. Research has been done on what knowledge and skills are needed for the next generation to face the challenges of climate change. To the mind of research participants, the most important practical skills for future specialists would be knowledge of computer technologies, new technology application, practical skills, awareness about the latest achievement in the field of climate change and adaptation management.

KEY WORDS: Climate Change; Education for Sustainable Development; Knowledge; Practical Skills; Masters Programme; Curriculum.

Introduction

World community is concerned about the possible consequences of the global climate change. The knowledge of processes taking place in nature is one of the links that contributes to the successful environmental management and the appropriate evaluation of risk factors followed by the application of preventive measures.

In the last decades climate change has caused impacts on natural and human systems on all continents and across the oceans (IPCC 2014). Socio-economic costs, associated with climate change damage and need for adaptation, are expected to escalate (Christel et al. 2018). Adaptation to climate change has gained a prominent place next to mitigation on global, national, and local policy agendas. However, while an abundance of adaptation strategies, plans, and programs have been developed, it is argued, that future research on climate change adaptation would require the involvement of not only scientific stakeholders, but also, in the research enterprise so as to co-define societally relevant problems to co-produce or co-create relevant knowledge, and to co-learn from these experience (Swart et al. 2014),.

Previous studies indicate that identified climate services as the most developed in Europe and North America, on the other hand, the majority of responses and research indicate that climate services are least developed in Africa (Vaughana et al. 2016). Climate services need to meet users' needs, capabilities and decision framings and thus collaboration with potential users from an early stage of the service design process is necessary to provide products and services that are likely to be used, including in education levels.

The principles for the enhancement of experiential learning in higher education and suggest how experiential learning can be applied throughout the educational environment by institutional development programs, including longitudinal outcome assessment, curriculum development, student development (Kolb et al. 2005). The Erasmus platform offers the opportunity to enhance experiential learning by including international experiences. The link between education and sustainable development is being addressed by extensive debates and research (Makrakis and Kostoulas-Makrakis 2012, 2012a). The world continues to face various critical challenges such as: human-induced climate change, the rapid depletion of natural resources, the frequency of natural disasters, and all these are closely related to the objectives addressed by education for sustainability (UNESCO 2005, 2010; Wals 2009). Indeed, three of the major forces shaping and driving the XXI century education are: (a) the development and diffusion of Information and Communication Technologies; (b) the increasing demand for new educational approaches and pedagogies that foster transformative and lifelong learning and (c) the reorientation of educational curricula to address sustainable development (Makrakis and Kostoulas-Makrakis 2012). Through its Climate Change Education for Sustainable Development program, UNESCO aims to make climate change education a more central and visible part of the international response to climate change. The United Nations Decade of Education for Sustainable Development reports has raised high expectations among countries and stakeholders who are committed to promoting and developing Education for Sustainable Development (Wals 2009).

According European Commissions reports the Bologna Process (2018) seeks to bring more coherence to higher education systems across Europe. Bologna reform is key to building the necessary trust for successful learning mobility, cross-border academic cooperation and the mutual recognition of study periods and qualifications earned abroad. Enhancing the quality and relevance of learning and teaching is also a core mission of the Bologna Process, however, implementation of these reforms is uneven across the 48 participating countries.

As part of the European Higher Education Area, all participating countries agreed to: introduce a three-cycle higher education system consisting of bachelor's, master's and doctoral studies ensure the mutual recognition of qualifications and learning periods abroad completed at other universities implement a system of quality assurance, to strengthen the quality and relevance of learning and teaching. Moreover, the new report outlines (Bologna Process Implementation Report 2018) the Bologna Process's most recent priorities: learning and teaching, social inclusion and employability.

The overall objective of these studies related with part of the Erasmus+ AdapTM project to continue the reform of the system of higher education in Egypt. Also to comply with the Bologna Declaration and according to the demands of the Strategic Framework for European Cooperation in Education and Training (ET 2020), aimed at improving the quality and efficiency of educational process, and to learn from experience and knowledge in the climate change, including growth in new technology application, adaptation in transdisciplinary knowledge and management.

The aim of the project is to ensure the design and implementation of an interdisciplinary degree study programme “Smart Environment and Climate Change Management” through conduction of joint interdisciplinary research, devoted to the synergy between theory and practice in sustainable development, in order to support Egypt with the integration of emerging technologies in environment management in a competence-based education system, hence advancing higher education according to the Bologna Process and European standards for quality of education.

The aim of this paper was to discover the stakeholders’ need of the experts in the given area and to determine the major professional and general competences, knowledge and skills the future graduates should possess in order to be successful in their future career. The research of students and alumni was carried out in order to understand their current knowledge on the environment and climate change management. The aim of this survey was also to find out what knowledge and skills students require for the climate change mitigation and adaptation studies.

This paper reports the results of an international survey to gauge community perspective on research and education priorities for climate services, highlighting several areas in which respondents agree on the need for future work and knowledge.

Data and methods

This paper reports the results of an international survey to gauge community perspective on research and education priorities for climate services, highlighting several areas in which respondents agree on the need for future work and knowledge.

The survey of labour market and stakeholders has been carried out in the form of questionnaire that included a range of questions important for the future successful work of the graduates of Master degree study program “Smart Environment and Climate Change management ”.

The aim of this survey was to discover the stakeholders’ need of the experts in the given area and to determine the major professional and general competences, knowledge and skills the future graduates should possess in order to be successful in their future career.

This survey was also useful to find out the situation in the labour market, i.e. what changes and perspectives in the institutions are expected in the future, what is the demand of such specialists and what expertise is expected from the graduates, wishing to work in the climate/environment change management field.

The questionnaire was distributed to the stakeholders from different regions of Europe and Egypt and different institutions. The total number of stakeholder organisations that took part in the survey is 159. The number of staff in stakeholder organisations varies from tens to thousands, the part of specialists in Smart environment change management varies from 10% to 35% with respect to the size of the organisation.

The research of students and alumni was carried out in order to understand their current knowledge on the environment and climate change management. 149 students and alumni took part in the survey. The aim of this survey was also to find out what knowledge and skills students require for the climate change mitigation and adaptation studies. To get a better representation of the climate change understanding and to get a broader view of knowledge and skills needed for the future graduates, the questionnaire was given to the alumni and students from different universities.

The survey received responses from different study programs students. The majority responds (76%)The majority (76%) represent study programmes in Environmental sciences namely Chemistry, Oceanography. 69 percent of students study Physical sciences (namely Physics, Physical oceanography), 64 percent – Marine sciences (including Ship and Port Operation management); 56 percent – Engineering (including Civil engineering). Some part of the students represents study programmes in Agriculture (36%), Veterinary medicine (24%), Microbiology (22%), Food safety (12%).

Results

The survey results indicate an overarching interest in knowledge that can better connect climate information to users, particularly around the communication of climate information.

Analysis of data of research of labour market and stakeholders' survey. As survey results show, there are some perspectives of development in organizations, so the staff downsizing in environmental sciences is not foreseen in none of the stakeholder institutions. Moreover, the expansion of institution leads to new job opportunities so in the future demand for specialists is likely to increase. Organizations are going to develop, open branch offices and increase staff recruitment. Again, this fact means that universities should be ready to prepare new generations of specialists that would occupy new work places in Environmental sciences.

Modern technologies are improving all the time, so it was necessary to find out if modernization and application of new technologies in environment change management is foreseen in institutions, so that the students would be qualified for that. As survey results show, more than two thirds (62,7%) of employers indicated that new technologies will be installed and new specialists will be required. That means that the development of technologies forces modern organizations to search for well-qualified specialists in Smart management and consequently universities should be ready to prepare such specialists for labor market.

Survey results also show that participating organizations are not going to reduce the activity that could potentially lead the downsizing of experts in Smart environment change management.

Regarding the demand for certain kind of Smart environment change management subjects, participating stakeholder companies pointed "Climate change as a whole" (71%). More specifically, the respondents defined the need for such subjects as "Smart technologies and management", "Climate management and industry", "Climate monitoring technologies" etc.

To find out what employers consider about the current situation and what changes, taking into account their opinion should be taken, the additional questions were given. Summarizing the responses, we can claim that in the background employers are quite satisfied with the preparation of the students in universities.

More than three quarters (80%) of stakeholder representatives pointed, that university gave the training for graduates in Environmental sciences to work in their company to a high or to a great degree. Nevertheless, about 20% responders think, that training was sufficient not enough, but only to some degree, so some changes in training procedure should be made.

Employers were asked to evaluate in scores (where 1 is the lowest, 5 is the highest) the quality of training of graduates in Environmental sciences, based on their personal experience.

Data shows that the situation is quite ambiguous: the theoretical training was evaluated in highest points. Almost two thirds of respondents (64%) positively evaluated the degree of the theoretical training. However, majority of the employers (67%), survey participants, are not satisfied with practical skills of the graduates so some changes should be done here.

Representatives of stakeholder organisations were asked to provide their opinion on the main strong features of the university / programme that would be important while training the future experts in Smart environment change management.

Slightly more than a half of survey participants (52%) emphasized that the quality of teaching staff is one of the strongest features of university studies. Lower number of respondents (48%) agrees that university studies provide students with the sufficient number of necessary information and literature resources. These are the strongest features of the university programmes according to survey participants.

The evaluation of the university programmes allowed defining the weakest sides of the university preparation. Only one quarter (23%) of research participants thinks that universities provide their graduates with the sufficient practical training. Even lower number of respondents (20%) evaluate graduates' research skills as sufficient for independent activity. Almost the same part of research participants (18%) stresses that universities do not use modern material and technical resources in their study programmes. One tenth (12%) of respondents mentions that graduates do not receive enough of professional trainings. To conclude with, it could be said that universities have as strong as weak features in the preparation of specialists in Environment change management.

Survey participants were asked to evaluate the need to improve certain areas of graduates training in physical and environmental sciences.

Almost all survey participants (97%) emphasized that the level and organisation of practical training should definitely be improved in the universities. Three quarters of the respondents (76%) voted for the option to conduct professional trainings of the students in companies. That means that stakeholder organisations would be eager to accept students for field-practice. This fact shows the desire of stakeholder organisations to participate actively in the preparation of future specialists in Environment change management. Three fifths of the respondents (64%) stressed that universities should draw more attention to research projects and develop students' skill of carrying out research activity. More than a half of survey participants (53%) think that material and technical resources should be improved in the universities. To sum up, in the opinion of research participant, the most important field to be improved in university studies is practical training of students. Representatives of stakeholder organisations would take an active part in the optimization of the preparation of specialists in Environmental sciences by providing them with field-based practice. According to informants, material and technical resources should also be improved in order to train highly-qualified specialists in Smart environment change management.

Survey participants were asked to evaluate the degree of importance of the fundamental knowledge and skills for an expert in environment and climate change management. Respondents' evaluation is presented in the table 1.

As it can be seen from the table, all listed fundamental knowledge and skills have been in general evaluated by the respondents as important. Major part of the respondents (89%) considers graduates' holistic understanding of environment change management through integration of innovative technologies, adaptation and mitigation as the most important knowledge to be developed in university programmes. Slightly lower number of the survey participants (86%) thinks that development of graduates 'essential technical skills is of a major importance. To sum up, it should be stated that university programmes have to focus on the development of fundamental knowledge and skills of students in order to prepare them effectively for the occupation in smart environment change management.

To the mind of research participants, the most important practical skills for future specialists in Smart environment change management would be knowledge of computer technologies, research skills, awareness about the latest achievement in the field of Environment change management. These practical skills were evaluated as "highly important" or "important" by almost all research participants. According to respondents, computational skills and knowledge of methods of data and information processing, skills of project development and management, leadership skills are also of a major importance for future graduates. These skills were considered as important by at least three quarters of survey participants. Small part of the respondents considered that skills of assessment of risks associated with the consumer use of presented information and produce, understanding of principles of quality assessment, control and management, ability to apply the principles of innovation management are not essential for the university graduates. So these skills could be developed directly during the professional activity if needed.

Analysis of student's questionnaire results. Almost all students survey participants (98%) stated that they have heard about the concept "climate change". Even more than two thirds of the respondents (64%) agree that the introduction of new technologies as well as sustainable management would help to preserve the climate and adapt to it. However, there is a small part of the survey participants who have never heard about the climate change (12%) or heard just partly (22%). It could be presupposed that some (16%) of this part of the respondents consider information about climate change irrelevant due to various reasons.

When answering to the question "Which sources of information about climate change appear reliable to you?" almost three quarters (73%) of respondents pointed that they would fully trust the government and some worldwide environmental organisations (72%). Approximately the half of the survey participants (54%) noted that they would believe mass media (TV, radio, newspapers, internet resources). So, only one third of students (32%) survey participants would ask scientists about climate change issues.

The answers to the question "What additional knowledge and skills do you require for climate change mitigation and adaptation studies?" are illustrated in figure 1.

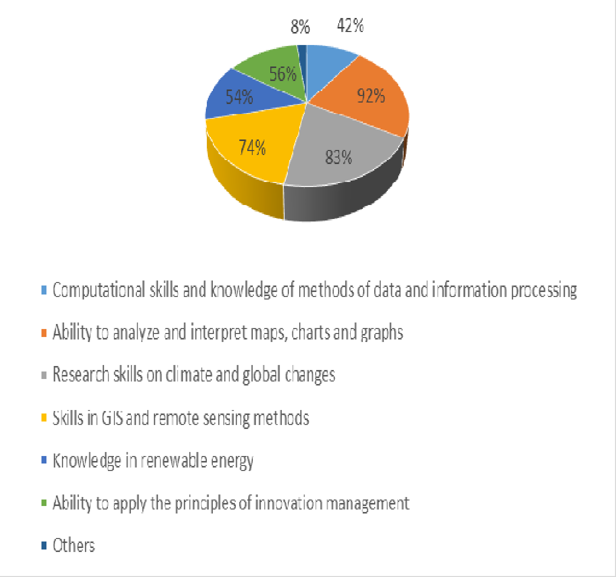

Fig. 1. Student's opinion on the knowledge and skills they require for climate change studies.

The major part of the survey participants (92%) expressed the need for the skills in interpreting of maps, charts and graphs to be developed. They also would like to acquire knowledge and skill in integration of all existing data for making a final diagnosis, conduction and monitoring of natural conditions in real time with the use of radar and satellite observations. Slightly more than three quarters (83%) of respondents pointed that they would require knowledge and skills in research on climate and global change. 74 percent of survey participants noted that they feel a need to develop skills of application of GIS and other remote sensing methods. Almost half of respondents mentioned the need for innovative management skills (56%) and knowledge on renewable energy (54%). To conclude with, it could be stated that potential Master students in Climate Change Management see the need in acquiring knowledge and skills in the most important fields such as analysis and research skills, application of new technologies.

More than four fifties (83%) of respondents stressed that climate change issues are very important and important to them personally. Probably this part of survey participants agrees that something should be done in order to tackle climate change (56%).

The answers to the question "Who do you think should have the main responsibility for tackling climate change?" are presented in figure 2.

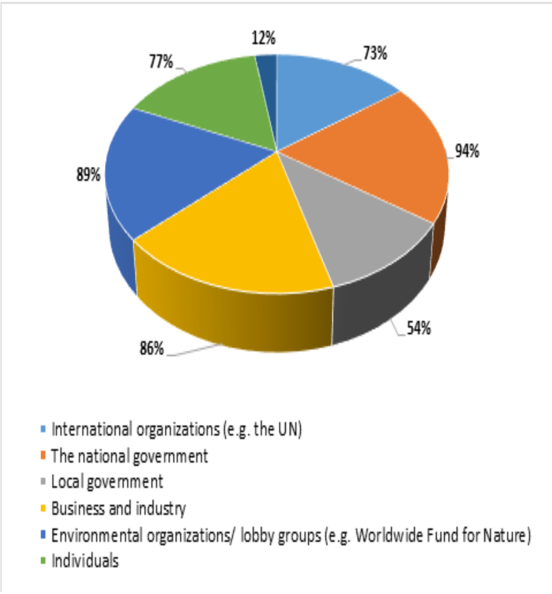

Fig. 2. Student's opinion on the responsibility for tackling climate change skills they require for climate change studies.

As shown in the chart (Fig. 2), the main part of research participants (94%) thinks that climate change tackling is the responsibility of National government. Three thirds of the respondents (89%) are sure that International organisations should be in charge of climate change issues. Whereas 86 percent of survey participants would delegate the responsibility for these problems to business and industry. To the mind of almost three thirds of respondents (73%) we ourselves are responsible for climate change. Summarizing the answers, it could be stated that students survey participants understand the importance of the issue of climate change and think that these problems should be monitored and examined on the national level.

Students were asked to indicate how much they agree or disagree with the statements about climate change management.

Almost all research participants (99%) strongly believe that climate change is an important issue and measures should be taken in order to tackle it effectively. Therefore, even more than two quarters (54%) disagree and strongly disagree that it is already too late to do anything about climate change.

96 percent of survey participants strongly agree or agree that human activity is responsible for climate change. However, two third (64%) of respondents think that natural variability has an impact on climate change. One third of research participants (31%) mentioned that climate change is just a natural fluctuation in earth's temperature.

Three thirds of respondents (92%) strongly believe that government should encourage initiatives on environment protection. However, even more respondents (97%) think that industry and business should be doing more to tackle climate change issues. 85 percent of respondents are sure that people can all do a bit to reduce the effects of climate change

Four fifths of the respondents (81%) think that pollution is the main cause that influences the climate change. More than a half of the respondents (54%) believe that energy consumption should be reduced in order to reduce the climate change.

In the opinion of the students (74%) recent floods or droughts in their country happened due to climate change. Moreover, 48 percent of respondents think that flooding (sea level) is tend to increase these days also due to climate change. The research results has also shown sociaty significant interest in understanding the drivers of climate extremes, that a warmer climate of world will lead to changes in the occurrence and magnitude of extreme events, including droughts, heavy rainfall and floods.

Table 1. Evaluation of the degree of importance of the fundamental knowledge and skills for an expert in environment and climate change management

Knowledge and skills	Very important	Important	Rather important	Neither important nor unimportant	Not important at all
Development of graduates' holistic understanding of environment change management through integration of innovative technologies, adaptation and mitigation	89%	11%	-	-	-
Development of graduates' conceptual and analytical skills to enable them to critically evaluate the projected impact of environment change on the economy and society, interconnections between natural and social geographical environment	73%	14%	13%	-	-
Development of graduates' skills of assessment of the solutions - at international, national and local level - that have been	54%	33%	13%	-	-

devised to address the impacts of environment change, either through technological change, policy, market mechanisms or regulation					
Development of graduates' essential technical skills (GIS, Remote Sensing, environmental engineering, modelling and monitoring, cartographical, mathematical and other geographical information receiving, analysis and interpretation methods)	86%	12%	2%	-	-

Conclusions

The survey results allow us to draw several broad conclusions about priorities within the climate change services and education field. Growing recognition on the part of the user community of the need to employ climate information to address challenges of variability and change.

Representatives of the stakeholder organizations, who participated in the survey, expressed the need for young specialists in Environmental sciences with Master level degree with climate change knowledge. Moreover, stakeholders pointed that in future the expansion of institutions will lead to new job opportunities so in the future demand for specialists is likely to increase.

When evaluating the degree of university training, stakeholder representatives stressed that usually it is more or less satisfactory, however theoretical training is of the better quality.

In their opinion, the most important field to be improved in university studies is practical training of students. Representatives of stakeholder organisations would take an active part in the optimization of the preparation of specialists in Environmental sciences by providing them with field-based practice.

According to respondents, uuniversity programmes, that prepare graduates in Environmental sciences, have to focus on the development of fundamental knowledge and skills of students in order to prepare them effectively for the occupation in smart environment change management. Graduates' holistic understanding of environment change management through integration of innovative technologies, adaptation and mitigation as the most important knowledge to be developed in university programmes.

The research of students and alumni was carried out in order to understand their current knowledge on the environment and climate change management. The aim of this survey was also to find out what knowledge and skills students require for the climate change mitigation and adaptation studies.

In the opinion of survey participants, climate change issues are of a major importance in the modern world and these problems should be monitored and examined on the national level involving national organisations, business and industry, research institutions and different education levels.

Moreover, according to respondents, human activity is responsible for climate change and adaptation. Therefore, government should encourage initiatives on environment protection and industry and business should be doing more to tackle climate change issues. Students mostly agree that the introduction of new technologies as well as sustainable management would help to preserve the climate and adapt to it.

To the mind of research participants, the most important practical skills for future specialists in Smart Environment and Climate Change management would be knowledge of computer technologies, practical skills, awareness about the latest achievement in the field of climate change sciences and adaptation management.

Acknowledgement

This work has been developed within the framework of the ERASMUS+ programs AdapTM project (No Project No. 585917-EPP-1-2017-1-IT-EPPKA2-CBHE-JP) that has been funded from the European Commission. The authors acknowledge the support of AdapTM project partners

This article was developed and discussed in WG3 of COST Action 16233, "Drylands facing Change: Interdisciplinary Research on Climate Change, Food Insecurity, Political Instability", funded by the EU.

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RECEIVED: 18 September 2019 **ACCEPTED: 22 October 2019**

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