Revista Brasileira de Cartografia (2017), Nº 69/1, Edição Especial Geotecnologias e Desastres Naturais: 1-11
Sociedade Brasileira de Cartografia, Geodésia, Fotogrametria e Sensoriamento Remoto
ISSN: 1808-0936

INTERNATIONAL COLLABORATIVE ONLINE EDUCATION PROGRAM: GEOSPATIAL TECHNOLOGY APPLIED TO DISASTER MANAGEMENT

Colaboração Internacional: Programa de Educação Online em Tecnologia Geoespacial Aplicada à Gestão de Desastres

Hilcéa S. Ferreira[1], Cleber Silva de Oliveira[2], Claudia Marcela Lucaccioni[1] & Pollyana Notargiacomo Mustaro[3]

[1]Instituto Nacional de Pesquisas Espaciais – INPE
Divisão de Processamento de Imagens
Av. dos Astronautas, 1758 - Jd. da Granja - São José dos Campos – SP, CEP: 12201-970, Brasil
{hilcea, claudia.lucaccioni}@dpi.inpe.br

[2]Instituto Federal de Educação, Ciência e Tecnologia de São Paulo – IFSP
Campus Guarulhos
Av. Salgado Filho, 3501 - Centro, Guarulhos - SP, CEP: 07115-000, Brasil
cleber@ifsp.edu.br

[3]Universidade Presbiteriana Mackenzie
Programa de Pós-Graduação em Engenharia Elétrica e Computação
Rua da Consolação, 930 - Consolação - São Paulo - SP, Brasil - 01302-907
pollyana.mustaro@mackenzie.br

Received on October 7, 2015/ Accepted on September 28, 2016
Recebido em 7 de Outubro, 2015/ Aceito em 28 de Setembro, 2016

ABSTRACT

Disaster Risk Management (DRM) continues to gain political, economic, and geopolitical importance as disasters have caused increasing human and economic losses. Geospatial professionals are attentive of the role of space-derived information in the full cycle of Disaster Management (prevention, preparedness and response), from beyond the immediate response phase to long-term recovery and even to preparedness by informing actions before disasters occur. It is crucial to develop and strengthen relationships with stakeholders and end-users, especially by developing capacity building activities for disaster managers and practitioners. The objective of this paper is to describe the process of establishing an international collaborative capacity development program, with experts from space agencies all around the world, in the Disaster Management area, from its conception to implementation. The strategy for designing the education program is discussed, taking into account financial and human resources and time constraints. The needs assessment and the instructional analysis including learning objectives, outcomes and audience have been performed. This study also includes the challenges of implementing the chosen instructional solution, lessons learned and practical suggestions for using synchronous technologies for instruction when implementing an international online education program in many different countries. The course was held from April 6t to May 31st, 2015, structured in eight webinars (online seminars) sessions. The demand for the online course (144 registrants from 38 countries in the world), diversity of affiliations and backgrounds confirms that this subject raises a lot of interest among professionals in need for quality education in this area.

Keywords: Disaster Management, Capacity Building, Online Education, Webinars, Geospatial Technology, Instructional Design.

RESUMO

A Gestão do Risco de Desastres tem adquirido importância política, econômica e geopolítica à medida que os desastres têm causado crescente perdas humanas e econômicas. Profissionais da área de tecnologia geoespacial estão atentos ao papel das informações obtidas a partir do espaço no ciclo completo de Gestão de Desastres (prevenção, preparação e resposta), desde a fase de resposta imediata até a recuperação em longo prazo, bem como, a prevenção, informando as ações antes que os desastres ocorram. É crucial que as relações com as partes interessadas e usuários finais sejam desenvolvidas e fortalecidas, especialmente por meio da proposição de atividades de capacitação para gestores de desastres e profissionais da área. O objetivo deste artigo é descrever o processo de criação de um programa de capacitação internacional, com peritos de agências espaciais de todo o mundo, na área de Gestão de Desastres, desde a sua concepção até a execução. A estratégia para a concepção do programa de educação é discutida, considerando-se os recursos financeiros e humanos e limitações de tempo. A avaliação das necessidades e a análise instrucional, incluindo objetivos de aprendizagem, resultados esperados e público-alvo, foram realizadas. Este estudo também inclui os desafios da aplicação da solução instrucional escolhida, ensinamentos colhidos e sugestões práticas para a utilização de tecnologias síncronas para instrução ao implementar um programa de educação on-line internacional em países diferentes. O curso foi realizado de 6 de Abril a 31 de Maio de 2015, composto por oito seminários online (*webinars*). A demanda pelo curso (144 inscritos procedentes de 38 países), diversidade de afiliações e formação dos participantes confirmam que este assunto suscita um grande interesse entre os profissionais em busca de educação continuada de qualidade nesta área.

Palavras chaves: Gestão de Desastres, Construção de Capacidades, Educação On-line, Seminários Virtuais, Tecnologia Geoespacial, Design Instrucional.

1. Introduction

Throughout the 21st century the environment is constantly changing whilst planet Earth has been facing increasing challenges. People around the world are suffering from poverty and malnutrition while others fear about the demand for natural resources and how much time we have before they run out.

According to the Group on Earth Observations - GEO (an intergovernmental body launched in 2005 to assemble a fuller picture of our planet, and to enable the science-informed decision-making needed to drive sound policy for the benefit of society): food, water and energy security, resilience to natural hazards, mitigation and adaptation to climate change and developing a sustainable economy are among our greatest global challenges (VISION FOR GEO 2025, 2014).

1.1 Context

These current environmental problems make us vulnerable to disasters and tragedies, now and in the future. Thus, Disaster Risk Management (DRM) continues to gain political, economic, and geopolitical importance as disasters have caused increasing human and economic losses. According to the 2015 Global Sustainable Development Report (UNDESA, 2015), since the year 2000, natural disasters have caused the loss of life of over 1.1 million and affected another 2.7 billion people.

While improvements in disaster risk management have led to dramatic reductions in mortality in some countries in the last decade, economic losses are now reaching an average of US$250 billion to US$300 billion each year.

1.2 Tackling the Disaster Issue

Several major international organizations such as the World Bank, the United Nations International Strategy for Disaster Reduction (UNISDR), and the European Commission are focusing their efforts on responding to crisis events after they've occurred (disaster response). However, as it is important to continue improving support to post-crisis response, it is also critical that governments invest in disaster prevention, preparedness and response (Disaster Management).

Motivated by the unique value of Earth observation data and products and key role to play in directly delivering societal benefits, in September 1984, the Committee on Earth Observation Satellites (CEOS) was established in response to a recommendation from a Panel of Experts on Remote Sensing from Space. From then on, CEOS has been coordinating civil space-borne observations of the Earth, where the participating agencies strive to enhance international coordination and data exchange and to optimize societal benefit. CEOS Agencies´ multilateral activities are coordinated by CEOS Working Groups which address cross discipline topics such as calibration/validation, data portals, capacity building, and common data processing standards as well as thematic topics such as climate and disasters (CEOS Web: http://www.ceos.org/).

The Working Group on Disasters (WGDisasters) initiated in 2013 a series of actions to support DRM more efficiently, with a focus on Disaster Risk Reduction (DRR), by optimizing and better coordinating satellite Earth observations. The working group overarching goals include increasing and strengthening satellite Earth observation contributions to the various disaster management phases and to inform politicians, decision-makers, and major stakeholders on the benefits of using satellite Earth Observations in each of those phases. The bottom line for achieving these goals relates to developing and strengthening relationships with stakeholders and end-users, especially by developing capacity building activities for disaster managers (CEOS WGDisasters Web: http://www.ceos.org/wgdisasters).

Aimed at unifying CEOS efforts toward providing wider and easier access to Earth Observation data, the Working Group on Capacity Building and Data Democracy (WGCapD) has been working in the direction of increasing the sharing of software tools (open source software and open systems interface), enhancing data dissemination capabilities, transferring relevant technologies to end users, and providing intensive capacity building, education, and training (CEOS WGCapD Web: http://www.ceos.org/wgcapd).

CEOS WGDisasters and WGCapD bring together the capacity (knowledge, expertise and tools) for undertaking a global initiative for empowering geospatial practitioners with tools and knowledge for tacking this important issue.

According to Gagné et al. (2005, p. 56), "When goals are matched with societal needs, an ideal condition exists for the planning of a total program of education". In the next sessions, we will provide a step-by-step approach for designing this global training program in the disaster management area.

2. INSTRUCTIONAL SYSTEMS DESIGN

Instructional Systems Design (ISD) is the process for creating instructional systems, aiming at engaging students and arranging resources and procedures to facilitate learning.

2.1 ADDIE Model: Analysis

Most systematic models of design have similar components, but can vary greatly regarding specific phases. As an organizing framework for this program, we used the ADDIE model, as it represents a guideline for building effective training and performance support tools in five phases: Analysis, Design, Development, Implementation and Evaluation (GAGNÉ *et al*., 2005).

Within the Analysis component, the first step is to undertake the Needs Assessment, identifying the goals for an instructional program, in an attempt to discover the gap between the desired goals and the current status.

WGCapD has observed that there is an increasing need, in less developed countries, for capacity development to produce Earth observations data, access and process data (using appropriate and accessible tools) into information, products and services that inform decision-making. In particular, WGDisasters has detected a gap in capacity development in the disaster management area.

The number of Earth-observing satellites has vastly increased while more satellites and complex data are made available every day - today the 55 CEOS Agencies operate 134 satellites. The user community has expanded and become more diverse as different data types become available and new applications for Earth observations are developed. In September 2014, during the United Nations Heads of State Climate Summit in New York, the White House announced that the highest-resolution topographic data generated from NASA's Shuttle Radar Topography Mission (SRTM) in 2000 would be released globally, free of charge. This is the highest quality digital elevation model (DEM) now publicly available. Among its many uses, the higher resolution data enables more accurate modeling of floods, coastal storm surges, mudslides, and volcanic lahar flows.

Geospatial professionals are attentive of the role of space-derived information in the full cycle of disaster management, from beyond the immediate response phase to long-term recovery and even to preparedness by informing actions before disasters occur.

In May of 2013 and March and May of 2015, three regional workshops organized by WGCapD and co-sponsored by Secure World Foundation (SWF) have been carried out in Kenya, South Africa and Mexico, respectively, focusing on hydrological and flood modeling, a key issue in the target regions. The workshops reached over 63 disaster management practitioners from six countries in Northeast Africa (Ethiopia, Kenya, Somalia, South Sudan, Uganda, Zambia), six countries in the Southern Africa region (Botswana, Lesotho, Madagascar, South Africa, Swaziland, Zimbabwe), and 11 countries in the Latin America and Caribbean region (Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Uruguay, and Venezuela) (SWF, 2015).

Face-to-face training programs such as these involve high costs in organization, transportation and lodging for participants and instructors. For better results, they also need to focus on a specific type of application (hydro-meteorological disasters, in this case) and a target region. Given that resources for capacity development are scarce and that there is a need for training worldwide in broader disaster management issues, members of CEOS WGCapD and WGDisasters have joined efforts to pursue a global collaborative program, free of charge, using online education. When instructors and students are scattered all around the world, online education tools help optimizing the time and cost of the process.

The course was aimed at: (1) Providing access to expertise from space agencies around the world; (2) Creating awareness about international coordination bodies, such as CEOS, GEO, the United Nations Office for Outer Space Affairs (UNOOSA) and the International Charter for Space and Major Disasters; (3) Providing access to datasets and useful tools available from CEOS Agencies; (4) Helping attendees develop skills to aid in Disaster Management (DM); (5) Linking participants to a global network of experts and policymakers.

Learning domains, sometimes referred to as categories of learning outcomes, are critical to consider when a professor/instructor plans his lessons. As listed above, we have identified four goals (1-4) lying on the cognitive domain and one on the affective and interpersonal domains (5), centered around motivation and willingness to participate through building relationships, interacting positively with others by fostering the construction of a community of learners in the field (KRATHWOHL *et al*., 1972; ROMISZOWSKI, 2009).

Activities and assessments can be better selected by analyzing the types of learning domains involved in the process. To achieve both cognitive and affective domains, self-assessment quizzes and discussion forums seemed adequate for this education program. Self-assessment allows students to monitor and evaluate their learning progress, leading to autonomous and self-learning. In addition, discussion forums promote interaction, increasing participant's motivation to learn.

The target audience for the course included professionals who have been pursuing to expand their knowledge and skills that can be directly transferred and applied to their jobs (continuing education / lifelong learning), preferably with reduced need to travel for training. Particularly, the aim was to reach Disaster Management practitioners with an interest in geospatial technology, with a prerequisite for elementary knowledge about remote sensing, Geographic Information Systems (GIS), and digital image processing. It was also expected that they would be proficient in the use of computers and had access to preferably high speed Internet.

The next session describes strategy used for designing the education program, considering financial and human resources and time constraints.

2.2 ADDIE Model: Design and Development

The following WGCapD & WGDisasters members participated as part of a core team for discussing the course syllabus, structure, and methodology:

- Brazilian National Institute for Space Research (INPE)
- Indian Space Research Organisation (ISRO)

United States Geological Survey (USGS)
- National Oceanic and Atmospheric Administration (NOAA)
- European Space Agency (ESA)
- National Aeronautics and Space Administration (NASA)
- CEOS Systems Engineering Office (SEO)

Some of our choices were based on limitations (financial and human resources) and lessons learned from the previous online education experience INPE has coordinated nationally and internationally (2013 CEOS International E-learning Course on Introduction to Remote Sensing Technology for Anglophone countries in Africa (FERREIRA *et al*., 2012; FERREIRA & MUSTARO, 2014).

To explore the potential applications of synchronous technology to enrich students learning, the team studied alternatives trying to find appropriate ways to integrate synchronous technology into an online education technology program.

The current economy along with technological advances and the growing need to provide information quickly and meaningfully to large audiences are among some of the reasons webinars (online seminars) have gained so much popularity lately. They provide a platform for sharing information with and receiving feedback and information from an audience without requiring that people gather in one physical location (LANDE, 2011).

The best solution found was to combine a series of live webinars, covering a wide range of subjects related to disaster management, with the use of a Learning Management System for making material available, assessment tools and fostering interaction among participants. Webinars create opportunities for both educators and learners to experience different levels of interaction online, and these opportunities are essentially different from other communication approaches (WANG & HSU, 2008).

The next session shows details of the implementation of the education program.

2.3 ADDIE Model: Implementation

The implementation phase in the ADDIE model includes details on the execution of the education program itself.

2.3.1Course Outline

The Online Education Course consisted of a series of eight introductory webinars addressing the use of remote sensing technology for Disaster Management (DM) and English was the course's official language.

The twelve instructor volunteers came from five CEOS Agencies (INPE, ISRO, NASA, ESA and USGS), universities, and training centers, such as the University of Waterloo (Canada), International Space University (ISU), and NASA ARSET (Applied Remote Sensing Training).

The themes of the eight webinars, held once a week from April 6th to May 31st, 2015, were as follows:

1. Introduction to the Webinar Series (Overview of CEOS/WGCapD; Where CEOS Can Help: Datasets and Useful Tools; International Collaboration for DRM: International Charter for Space and Major Disasters)
2. Introduction to Disasters: Causes, Effects, Monitoring, Mitigation, and Management. Methods of Hazard, Vulnerability, and Risk Assessment and the Role of Geospatial Data.
3. Space-based Earth Observation Systems and their Applications for Hydro-meteorological Disasters (Floods)
4. Space-based Earth Observation Systems and their Applications for Geological Disasters (Earthquakes, Landslides, and Volcanoes)
5. Space-based Earth Observation Systems for Environmental Disasters (Forest Fires)
6. Real Time Monitoring of Global Precipitation from Space: New Technologies Applied to Heavy Rainfall Risk Reduction
7. Concepts and Applications of Internet GIS and Sensor Web (Network of Sensors) for Disaster Management. Example of an open source tool TerraMA2 (http://www.dpi.inpe.br/terrama2/doku.php?id=english:mainpage)
8. Rapid Mapping and Emergency Services: Success Stories - International Charter for Space and Major Disasters (http://www.disasterscharter.org/)

In March 2015, the course was advertised via CEOS website, mailing lists and CEOS social media channels (Facebook and Twitter).

The methodology of this course was based on online distance education program principles that allow participants to fully engage with program content, their peers, and their instructors via live lectures, question/answer through discussion forums, and feedback mechanisms.

Web-conferencing platforms (computer-mediated communication) have gained popularity among educators during the past decade due to greater flexibility as a result of web technology and broadband connectivity improvements. They provide educators with synchronous, multimodal communication opportunities through products such as Adobe Connect, Blackboard Collaborate, and Big Blue Button (WANG *et al*., 2013). For this education program, the platform chosen for synchronous communications was Citrix GoToWebinar, since CEOS community had already familiarity with Citrix similar tools.

To optimize participation in the webinar sessions, minimizing the impact of the different time zones, the synchronous sessions were scheduled once a week, on Tuesdays, at 10 a.m., UTC time. Furthermore, to overcome possible problems with limited internet access bandwidth, two strategies were adopted: development of lightweight and easy uploading presentations and recording of webinar sessions, making them available for watching or downloading.

Each live classroom session was recorded and made available for download afterward.

Course materials included well-organized presentations, selected datasets, and various resources from the internet.

The Modular Object-Oriented Dynamic Learning Environment, Moodle, was used for course administration, documentation, tracking, reporting, and delivery. Moodle helped fostering interaction between instructors and students with different backgrounds.

The pre-webinar and post-webinar phases of this course required significant effort. In the pre-webinar phase, instructors uploaded their learning materials to Moodle, prepared their course quiz questions, and developed their 1-hour lectures for presentation during the webinar (including 10 minutes for questions). The GoToWebinar System allowed us to interact with students well, with features such as registration, invitations, and reminders. We also held practice-sessions with course instructors one week before webinars began to familiarize them with the software, material, and organizational flow. The post-webinar phase included the compilation of surveys and questions to be posted on the discussion forum. We advised instructors to log in to Moodle during the week of their webinar at least once a day to answer student questions inside the Course Discussion Forum (LANDE, 2011).

Although access to course materials required user authentication in Moodle, we later made course materials freely and publicly available on the Course Wiki (http://wiki.obt.inpe.br/doku.php?id=webinars-disasters), as motivated by the Open Educational Resources initiative.

In an effort to provide wider access to learning materials, especially for users without consistently available access to high-speed internet, we have contacted GEONETCast representatives (http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/GEONETCast/index.html) to see if they could make them available through the GEONETCast Training Channels.

GEONETCast is a near real time, global network of satellite-based data dissemination systems designed to distribute space-based and in-situ data, metadata, and products to diverse communities. It is a system co-operated by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), National Oceanic and Atmospheric Administration (NOAA), the China Meteorological Administration (CMA), and the World Meteorological Organization (WMO). GEONETCast Broadcast Streams are composed by EUMETCast (coverage over Europe, Africa and the Americas), CMACast (coverage over the Asia Pacific region), and GEONETCast Americas (coverage over the Americas). EUMETCast and GEONETCast Americas Training Channels are now operational over Europe, Africa, and the Americas and deliver open access course materials to targeted audiences, which is ideal for distance learning courses. Detailed instructions were sent to all students on how to access this material through these channels.

2.3.2 Students Profiles

144 students initially registered for the course, but, due to GoToWebinar space constraints, we could only accept 99 of them on

a first-come first-served basis. The geographic distribution of course students by continent is shown in Figure 1:

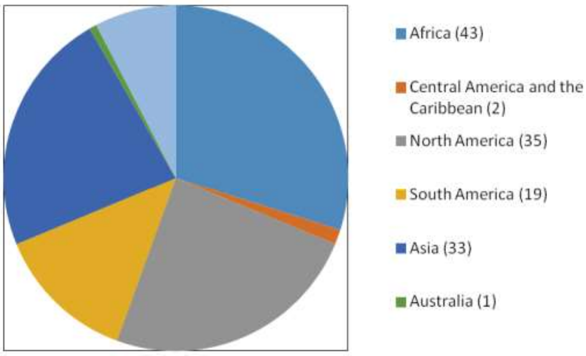

Fig. 1 – Geographic distribution of all 144 registrants.

All students selected had bachelor's degrees (or higher) in a wide variety of disciplines: Geography, Science, Engineering, Agronomy, Geology, Physics, Hydrology, Computer Science, Meteorology, and more. Forty-two students held a Master of Science degree, and 11 held doctoral degrees. Most of them either had remote-sensing and GIS specializations or had been working in the field for many years.

Student affiliations included universities, United Nations Regional Centers, Regional Centers, Government, Private Sector and Non-Governmental Organizations (NGOs).

Most students were interested in taking the course for professional, academic and personal development, wanting to deepen their knowledge on the use of satellite imagery and tools for disaster management, improve their understanding of geospatial technology, and stay up-to-date with the latest trends and applications in this important field (Figure 2).

Fig. 2 - Topics of interest for students that took this course.

2.3.3 Overall Results

Webinar session attendance decreased as the course progressed. By the end of the course, 46 out of the 99 enrolled students received a Certificate of Participation. It is important to mention that six students who participated in the CEOS International E-learning Course on Introduction to Remote Sensing Technology (2013) also enrolled for this course and successfully completed it. This confirms the current need for continuing education on Geospatial Technology as a broad and specifically within disasters management. These students are lifelong learners and showed faithfulness to CEOS capacity building programs.

Initially, the criterion for receiving the certificate was attendance of all live webinar sessions. However, this kind of program, where participants are spread all over the world in different time zones, needs some flexibility. Throughout the course, many students sent emails apologizing for not attending specific sessions due to their job duties. Through Moodle logs it was possible to confirm that some of them accessed the recordings of the sessions afterwards. Ongoing participation in quizzes and the discussion forums also demonstrate active participation. Thus, we decided to provide the Certificate to students who attended at least four live sessions and attempted at least four quizzes.

Figure 3 provides more detail about webinar attendance. Notice that some students did not attend the live sessions, but did access the recordings and take the quizzes afterwards.

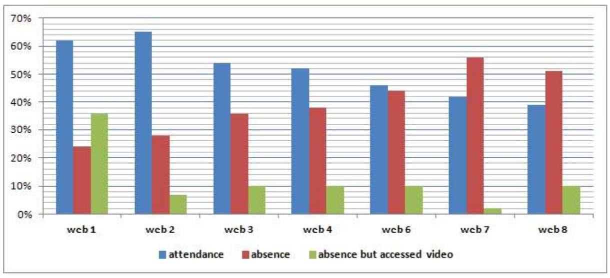

Fig. 3 - Webinar overall attendance.

The quizzes were optional and were meant for self-assessment purposes only. Table 1 shows the number of students that took the quizzes (only nine students took all the quizzes, and the average score was 78.9).

Table 1: Number of students that took each quiz

Q. 1	Q. 2	Q. 3	Q. 4	Q. 6	Q. 7	Q. 8
30	30	37	41	24	23	18

The successful participants received a congratulations email together with the attached Certificate of Participation. The instructors also received a Certificate of Appreciation. Figure 4 shows the number of students (organized by country) who received the Certificate.

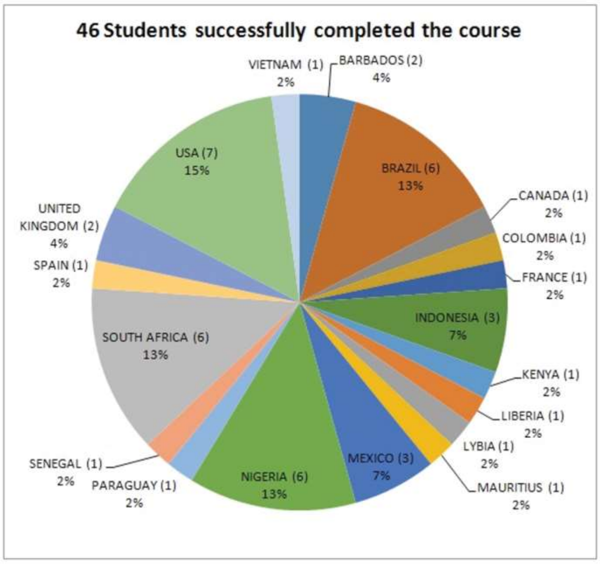

Fig. 4 - Successful students by country.

Regarding their affiliation, most successful students, 44%, came from Government organizations, as depicted in Figure 5:

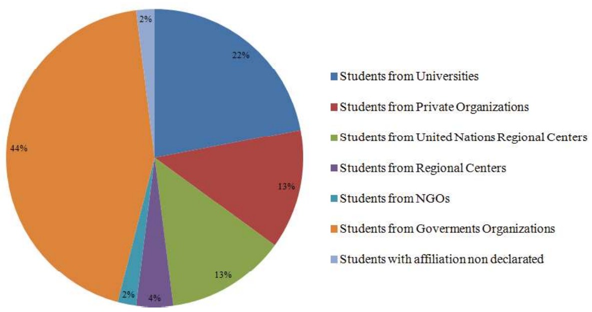

Fig. 5 - Successful Students Affiliations.

We asked students to participate in a follow-up survey on Moodle to evaluate the effectiveness of the course and receive feedback on how to improve the course. 46 students (37 that successfully completed the course and nine that did not) completed the survey, which included yes/no, multiple choice, and open-ended questions. The results of this study are presented in the next session.

2.4 ADDIE Model: Evaluation

The results of our study reveal that most students (80%) Strongly Agreed or Agreed with the statement "This course met my expectations." 18% of students were Neutral about the statement, and 2% of the students disagreed with the statement. Furthermore, the majority of participants gave the course high scores: Excellent (28%) and Very Good (50%). 18% of the audience evaluated the course as Good, and 4% evaluated the course as Poor or Fair.

It is interesting to observe that for most students, the objectives of the course were clear (almost 85%); this percentage could explain their level of satisfaction. The students also evaluated the software used during the course (Moodle and GoToWebinar), the learning materials (presentations, quizzes, and tutorials), the instructors´ performances, and the course contents. In general, all of these items scored very well, most of them scoring Good, Very Good, and Excellent. Figure 6 explains these categories in more detail.

In order to receive more specific feedback from the students, there was an open-ended question in the survey: "Which parts of the course did you find most/least helpful". The main advantage mentioned for taking this online course was the ability to attend the lectures without having to travel to the class, saving money and time that would otherwise be spent on transportation. A small number of students reported internet connection issues, but since the online sessions were recorded, they were able to download and watch them later.

While, in general, the feedback was positive, participants also had some suggestions and comments. The issues most commented upon were related to requests for more hands-on activities and practice exercises using a GIS, further demonstrations and presentations of real scenarios and techniques in software used for analyzing the data and inclusion of real processing of data instead of results. Demonstrate how to derive maps and products.

Regarding the course structure, students suggested more time for questions at each session and encouraged more interaction among participants.

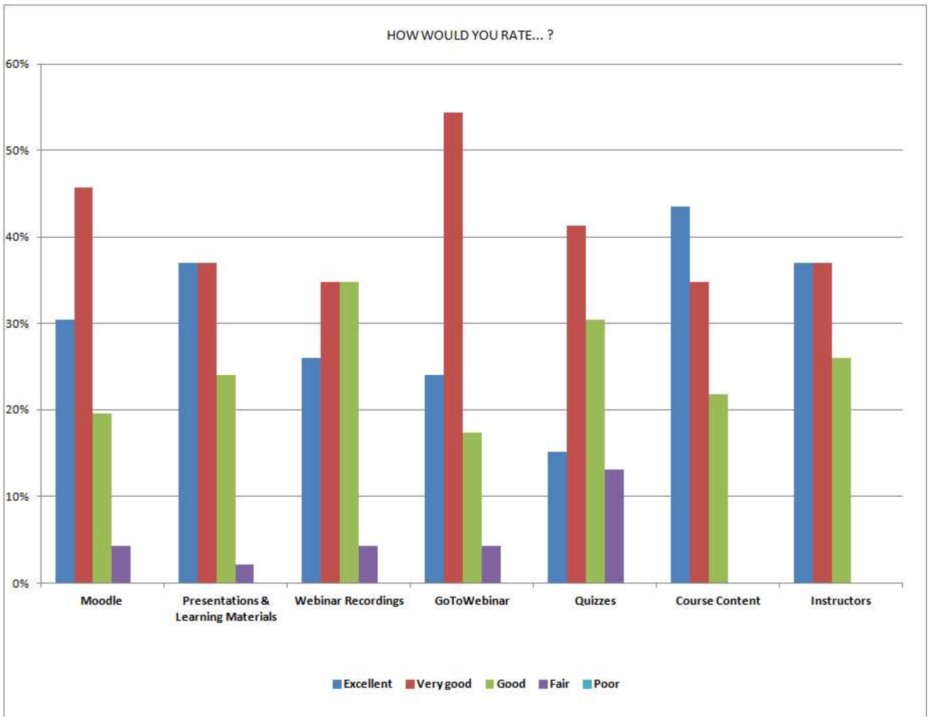

Fig.6 - Course Evaluation.

On the assessment issue, some of them suggested more in depth and technical quizzes or even substituting them for activities.

100% of the students said that they would recommend this or a similar webinar series to a colleague/friend to attend in the future.

Though most students agreed on the usefulness of each webinar, they individually recommended some topics to be added in future editions of the course: (1) Using remote-sensing for agriculture, especially by small-scale farmers; (2) Newly available satellites and accessing historical data archives; (3) Early warning; (4) Crowd-sourcing and disaster management; (5) Nowcasting of meteorological disasters; (6) Flood monitoring and simulations; (7) Software and techniques used for analyzing the data; (8) Another session about the use of bandwidth and channel in the satellite image; (9) Applications of Remote-sensing and GIS in flood management; (10) Image processing/analysis; (11) Modeling of remote-sensing data for disaster management; (12) Applications of GIS for epidemiology, disease outbreaks and public health issues, Oil spills, waste management; (13) Real Time Monitoring of Forest Fires.

3. LESSONS LEARNED AND CONCLUSIONS

Overall, this course successfully provided students with access to a multicultural educational experience in Remote Sensing as Applied to Disaster Management. The course accomplished the following goals:

- Created awareness about international coordination bodies, such as CEOS, Group on Earth Observations (GEO), and the International Charter for Space and Major Disasters as major sources of data for DM.
- Increased knowledge about data availability through the International Charter during a disaster and how it can be activated.
- Increased knowledge about using satellite Earth observation data from different sources for DM.
- Increased knowledge about how to determine which specific GIS capabilities and data types are required to support emergency management work before, during, and after a disaster strikes.
- Improved student ability to advise decision makers about how to use space technology for DM.
- Fostered the construction of a community of learners in the field.

Although it was emphasized (in the announcement, course syllabus, etc.) that this was a distance course that would integrate webinar technology with a longer-term online learning environment (Moodle), student interaction via the discussion forums (the main tool for asynchronous communication) was low. This may have resulted from a misconception about the course methodology. Webinars (virtual seminars), by definition, differ from online courses in that online courses span a greater time frame and engage students in continuous online discussion threads about topics and assignments. Nevertheless, through the webinar sessions, the goal of creating a network of contacts for further professional exchange was achieved.

The biggest challenges faced by instructors during the webinar sessions were centered on how to keep the students engaged in the online learning setting (e.g. appropriate presentation length and format). Instructors used polls and surveys during the webinars in an effort to prevent students from losing focus and engaging too heavily in unrelated tasks during the webinars (i.e. multitasking). Polls and surveys also help instructors gauge how well the students are understanding the information (or how much they already know). It is hard to replicate the atmosphere of a face-to-face environment, even with synchronous communication tools. Despite the limitations of this methodology, students highly appreciate when instructors use various strategies to motivate or catch their attention.

For future courses in this format, we should consider limiting webinar lectures to 45 minutes in length to allow more time for questions and interaction with students.

It was essential to have a moderator present in each webinar to help troubleshoot webinar technology without distracting the instructors. The moderator also helped manage questions from students during the session.

The feedback and suggestions from students reflect their need for more hands-on activities and software/real scenarios demonstrations. According to Lande´s (2011) findings, participants preferred learning conceptual knowledge rather than procedural (hands-on) skills via webinar, and instructors felt the webinar venue was not effective in transferring procedural knowledge because they could not observe students' performance or provide feedback. For considering this feedback as we plan future courses, we shall need to rethink the education program, limiting the number of students for each webinar session and planning more activities inside Moodle that allow introducing practical assignments and proper feedback to students.

An opportunity for capacity development in DM is being organized by the Canadian Space Agency (CSA) to be held on October 29, 2015, in Quebec City, Canada: "Workshop on Civil Security: Understanding the Risks, Preventing Disasters and Mitigating the Impacts with EO Applications and Services" (http://ceos.org/meetings/civil-security-and-eo-workshop/). It will include 11 presentations (9 in French, 2 in English) highlighting the successful use and integration satellite Earth observations by various clients and end-users. Besides in situ participation, WGCapD will be coordinating an online session and has invited all students that registered for the online education program to join in. From 27 registered participants, 18 are from this education program. This corroborates the importance of continuous education programs in the Geospatial Technology area and network building and confirms students´ faithfulness in CEOS capacity building programs.

Finally, it is important to highlight that this kind of initiative is only possible with commitment and dedication of all team of instructors and contributors, to whom we really show our appreciation.

ACKNOWLEDGMENTS

The authors wish to thank the financial support of MackPesquisa to develop this research.

REFERENCES

FERREIRA, H. S.; MUSTARO, P. N. Remote Sensing Technology Online Education in Africa: a Multicultural Experience. In **INTED2014 Proceedings**: 8th International Technology, Education and Development Conference. Valencia, Spain, p. 3593-3601, 2014.

FERREIRA, H. S.; FLORENZANO, T.G.; MELLO, E. M. K.; LIMA, S. F. S. . Building Capacity in Remote Sensing Using Distance Learning. RBC. **Revista Brasileira de Cartografia (Online)**, 64 (6), p. 863-872, 2012.

GAGNÉ R. M.; WAGER, W. W.; GOLAS, K.; KELLER, J. M. **Principles of instructional design**. Wiley Online Library, 2005. 371p.

KRATHWOHL, D.R.; BLOOM, B.S.; MASIA, B.B. **Taxonomy of Educational Objectives, the Classification of Educational Goals.**

Handbook II: Affective Domain. New York: David McKay Co., Inc., 1973. 196p.

LANDE, L. M. Webinar Best Practices: From Invitation to Evaluation (Doctoral dissertation, University of Wisconsin-Stout), 2011. Available at <http://citeseerx.ist.psu.edu/viewdoc/