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Development of Crisis and Emergency Risk Communication (CERC) activities and an Evaluation of their Impact on Learning: Geoscience students perception.

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Abstract

Recently, the recognition of Crisis and Emergency Risk Communication (CERC) tools in natural hazard management and disaster reduction has gained prominence. A successful CERC will ensure the relevant stakeholders are effective communicating with each other. This requires a clear plan and set of principles that enables the stakeholders to function effectively in a crisis. Students hoping to work in the emergency and natural hazard management field need to develop these skills. This paper outlines the development of a range of risk communicating activities including simulation exercises for undergraduate Geoscience students. Progress in the development of the students risk communication skill through the series of activities is tracked and evaluated. Results indicate that 87% of the students perceived their risk communication skills were good or excellent after undertaking the exercises compared to 26% before. This paper also evaluates the impact of the activities and if they motivated them to learn more about the subject as a whole. Students generally indicated that the exercises motivated them to learn more about natural hazard management and they felt that they have become better risk communicators. They also indicate that they gained a more in-depth understanding of the requirements of effective and timely communications should they need to develop a CERC strategy during a crisis.

Keywords:

Risk Communication, CERC, Geoscience students, learning, Social media

1. Introduction

Crisis and Emergency Risk Communication (CERC) is an increasingly recognised part of the arsenal of disaster risk-reduction (Brewer, 2011, Palenchar, 2010). The recent legal dispute relating to the L'Aquila earthquake in Italy, where six scientists and a government official are being prosecuted for their deemed ineffectiveness in communicating the 'correct' level of risk to the relevant stakeholders, including the public, highlights this issue (BBC, 2012). All stakeholders involved in risk reduction need a way to communicate about present, emerging and evolving risks that are understandable to each other (Coombs, 2012*)*. When there is an effective CERC in place and all the relevant stakeholders are included in the process, communicating with each other in a clear, concise and unambiguous manner *"allows individuals or an entire community to make the best possible decisions about their well-being" (*CDS, 2012, p.7). An effective CERC ensures that the relevant stakeholders are communicating with each other and that there is a plan and set of principles, which all are aware of and fully understand, that allow stakeholders to communicate the right message in a timely manner and in a way that people actually understand and can act upon in a crisis (Palenchar, 2008). CERC personnel often work under impossible time constraints and must both accept and communicate uncertainty of risk to a wide range of stakeholders, which can be very challenging. The most important element of an effective CERC is well-trained personnel (Covello, 1992). However, making the best decisions depends largely on experience and training (CDS, 2012). Training helps the individual to learn about CERC strategies that will help prepare for and respond to public emergencies effectively, including: how to review and disseminate risk information as well as emerging/current crisis and

emergency risk information, and how to systematically plan, develop, implement, and evaluate crisis and emergency risk communication activities.
As such, this paper aims to evaluate the development of risk communications skills amongst a group of Geoscience students studying Natural Hazard Management at an undergraduate level at the University of Chester, UK. This paper evaluates the student's perception of their developing CERC skills through a series of exercises, including: how well they engaged with CERC strategies and their perceptions of the limitations of the techniques used. CERC skills were developed through the use and evaluation of hazard mapping, risk perception analysis, field and lab presentations, and the development of a natural hazard management and response exercise using Web 2.0 technology (Yammer).
Of course, effective curriculum design considers what is to be learnt, the qualities of the learning experience and how learning should take place. Evaluation offers educators an understanding of the level to which students have advanced in their skills, knowledge and attitudes (Wile, 2009). Further, there is great value in students evaluating their own skills because self-evaluation can *"enhance [student] efficacy and maintain motivation"* (Schunk, 2003: p162). Questionnaires and a focus group were used to evaluate the students' perceptions of how their CERC exercises (including crisis simulation exercise) developed their communications skills and whether this motivated them to learn. This paper presents the results.

2. Risk and Crisis Communication

Historically, risk and crisis communication were viewed as two separate fields (CDS, 2012). However, in recent years, the two are merged, often from both an academic and practitioner's perspective. Risk communication is *the "process of exchanging information among interested parties about the nature, magnitude, significance or control of a risk"* (Covello, 1992: p. 359). In essence, risk communication should be about the effective exchange of information about an adverse and/or potentially adverse event, which helps various stakeholders to make timely decisions to reduce the negative impacts from such an event, including any potential loss of lives (Heath & O'Hair, 2010). Crisis communication describes the communication activities of an organisation/agency facing a crisis and/or the need to inform the public of actions they need to take during an emergency (CDS, 2012: p8). Effective risk communication helps inform and alert the public about an unfolding or potentially hazardous event and about how the hazard could be controlled or mitigated. Effective crisis communication focuses on how a hazardous event is being controlled or contained, on mitigation measures and whether or not the risk management strategy is proving effective (Coombs, 2010). Both are skill sets that practitioners in the field of hazard mitigation need in order to disseminate information about a potential disaster, a crisis event and/or the recovery process after a disaster effectively (CDS, 2012; Smith & Petley, 2009; Alexander, 2002). Students who aspire to work in the field of hazard management agree that it is important that they have an opportunity to develop such skills as part of their undergraduate training (Miller & France, 2012). The exercises outlined here aim to help students in this regard.

2.1 Use of technology for risk communication exercises

The use of digital technology, such as Geographical Information Systems (GIS) and Web 2.0 tools, played an integral role in all the CERC activities undertaken by the students. In a digital era, students expect technology to be an integral part of their higher education courses (Conacannon et al., 2005). Knight (2006, p.19) highlights the importance of integrating traditional teaching methods with technology to achieve *"blended learning"* wherein *"a*

range of students' learning approaches and skills are developed" (e.g. Lonsdale et al. 2004, Motteram 2006). Dyson et al. (2015) suggest that, while the integration of social media may be challenging, there are numerous examples of how social media *can "engage students and improve connectivity between student groups"* (Welsh & France, 2012, p.47) through the use of tools such as Twitter (e.g. Linsey et al., 2011) and Yammer (Miller & France 2013). Here, the CERC simulation used Yammer.

3. Methodology: Developing and Evaluating Risk Communication Skills.

The general methodology adopted has two components. First, a range of techniques is explored to encourage the development of the students' risk communications skills, including the 'Mental Model' approach. Second, the students' perception of their risk communication skills is evaluated by means of questionnaires and a focus group.

3.1. Development of Risk Communication Skills

The Mental Model approach explores *"webs of belief that guide learning and interpretation and through decision-making, define judgment and shape behaviour"* **(**Decision Partner LLC, 2008, p.2.)**.** These 'beliefs' are developed by giving practitioners the opportunity to practice, to learn from mistakes and to reflect on their performance. As highlighted by Morgan et al. (2001), who utilised the 'Mental Model' concept to explain the effectiveness of risk communication, risk perception analysis needs to be undertaken prior to the event so that the most effective message can be deployed during the crisis. Risk perception analysis also offers an understanding of the areas of convergence and divergence between how the public and experts view the risk. Identifying gaps between stakeholder perceptions allows consideration of how best to bridge those gaps. Information gathered from risk perception analysis thus helps communicators develop effective awareness and education programs. As CDS (2012, p.12) indicates *"It also offers a way for the general public to understand how the risks they face are created and controlled, how well science understands those risks, and how significant they seem to be."*

Following the principles of the 'Mental Model', students undertook tasks designed to develop their CERC skills through different stages of the disaster management cycle from the preparation/mitigation stage (e.g. risk mapping and identification) through to Response stage (Emergency Management and Operations). The tasks given to students included exploring how to:

i) Use of technology identify, map and inventory natural hazards;
ii) Undertake field surveys; interview a range of stakeholders, such as NGOs, risk assessors, and volcanologists, and analysing the data gathered, both qualitatively and quantitatively through statistical analysis, so developing the correct message to be communicated;
iii) Speak to and evaluate the public perception of risk, explore the barriers to effective communication and, in so doing, to develop a comprehension of the public understanding of risk that will enable them to better adapt their message to the intended target audience;
iv). Participate in a simulation exercise focusing on Emergency Management and Operations to obtain a more 'realistic feel' of the pressures and expectations in a crisis situation and of the need to communicate, in a timely manner, the right message to the right stakeholder.

These tasks were set to 138 students in their final year of undergraduate studies in the context of a course in Natural Hazard Management at the University of Chester, UK. The aim was to demonstrate the fundamentals of CERC and to provide an opportunity to develop skills and apply knowledge learnt.

Identification, mapping and presentation of hazard information, along with gaining an understanding of public perception of risk, are the first stages of risk communication (Fediuk et al., 2010; Fischhoff, 1995). Without these data, subsequent risk communications may be highly flawed and ineffective (Roberto et al., 2009). Hence, the first activities that the students undertook involved risk identification and risk mapping and the evaluation of public perceptions. Subsequently, students presented their findings to a range of stakeholders (e.g. physical scientist, social scientist, residents in the high-risk zone).

An effective risk communicator understands the public perception of the risk, which can be highly affected by social and cultural factors that create inconsistent evaluations of risk in the general public mind (Slovic, 1987). To enable students to develop this understanding, they were set tasks including: the developing and administering of questionnaires, conducting interviews and surveys, evaluating and presenting results from interviews and surveys, and critiquing a national emergency plan. Subsequently, students were required to develop and test their risk communication concept across all the stages of the disaster management cycle through simulation (CDS, 2012). This simulation covered a volcanic eruption scenario from the pre-crisis (preparation) to crisis (eruption) and used the Web 2.0 social network Yammer as the communication tool (see: Miller & France, 2012).

3.2 Identifying the risk and communicating the findings

Risk identification, the first crucial stage in disaster risk reduction, involves the systematic mapping and understanding of physical risk factors (Rowan et al., 2010). Here, students engaged in a range of risk mapping and evaluation activities that included fieldwork, geomorphic analysis, the use of remote sensing data in mapping (see Figure 1), and the integration of data in a GIS to create risk and predictive models. The findings were explained to a range of simulated stakeholders (see Figure 2). Feedback was supplied throughout to help the students understand how effective they were in communicating the information and how to improve their risk communication skills.

Figure 1. Students utilising photogrammetric mapping to identify risk

Figure 2. Students presenting risk evaluation findings during a field presentation

3.3. Understanding the public and developing communication skills

Crisis and Emergency Risk Communications (CERC) often fail when the communicator lacks understanding of their audience (Morgan et al., 2002). To be effective, it is imperative that the communicator understands how the public perceives the potential risk and those factors that may influence their responses in a crisis. The key is to ensure that the CERC message is properly tailored and targeted and that the stakeholders are both prepared and able to take action to protect themselves ((Fischhoff, 1995; Adam & Van Loon, 2000).

The 'Mental Model' approach helps practitioners develop effective risk communication skills (Morgan et al., 2002; Adam & Van Loon, 2000). The Model provides a holistic approach to risk communication. It encourages an understanding of public perceptions and hence: how to develop effective messages to engage the public; how to test those messages and evaluate the message's impact through raised awareness; how to improve knowledge of the risks faced, and how to develop appropriate preventative and preparatory measures (Morgan et al. 2002).

To help students better understand the public perception of risk and so tailor their messages effectively through mass media, they first prepared questionnaires to evaluate the public's perception of the risk in their case study area. This was done in for a number of natural hazards including floods and volcanoes both in the UK and Bay of Naples Italy. Once designed, the questionnaires were administered 'face to face' (see Figure 3) and the survey results evaluated. By administering the questionnaire, face to face with 'the public', the students were better able to interact with their target audience and, hopefully, to get a better sense of the challenges involved in engaging a diverse group. The lessons learnt were used to develop a message for communication to a larger audience via the media. To help students become familiar with communicating with the media, they were offered opportunities to work with media personnel and taught how to respond to questions from journalists, members of the public, etc., (Figure 4).

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Figure 3. Students undertaking survey in the field

Figure 4. Students practicing communication skills and how to engage with the media

3.4 Bringing it all together: Simulation Exercise

Beyond the theoretical aspects of risk communication, students need opportunities to engage with the practical problems of reactive communication during a crisis. Of course, real-world opportunities are limited as employers are reluctant to provide inexperienced students with practical experience during a real emergency, particularly where lives and livelihoods are at stake (Miller & France, 2013). However, simulation exercises can provide students with a 'real-world' feel and offer an opportunity to develop reactive risk communication skills

(Alexander, 2002). Research has highlighted the benefits of the approach. For example, Kos (2009) developed a web based 'e-scenario online hazards simulation for the Swiss Alps while Alastair et al., (2010) used emailing and Short Messaging Service (SMS) in CERC exercises. Simulations, using readily available and familiar technologies, allow learners to *"grapple with real-world problems, access appropriate information quickly and easily construct new knowledge and meaning for themselves in a relevant interesting context"* (Lynch et al., 2008, p.137). Simulation also helps students understand the requirements of each stage of the communication cycle, including the communication protocols and reporting structures that apply in emergency situations (Fediuk et al., 2010). In real-world contexts, failures in these areas can escalate an ongoing disaster and make its management more difficult (Flynn et al., 2001).

Here, the Web 2.0 social media technology, Yammer was used as the communication tool (Miller & France, 2012). Yammer can provide a closed communication system linked to the university address, which does not allow information to enter the public domain. The simulation, which involved an anticipated eruption of Mount Vesuvius, goes through the full disaster management cycle (mitigation, preparedness, response, recovery). Prior to the simulation exercise, students were provided with documents and roles (see Figure 5), access to maps, a field visit to the area, access to a Geographical Information System (GIS) (see Figure 6), and training in the use of the communication tool provided.

Figure 5. Communication Pathway: outline of participants roles during the CERC simulation exercise.

To support the simulation, videos (e.g. helicopter flying over the crater with scientific reports, news reports), live update of monitoring (e.g. mitigation stage), fissure eruptions (preparation

stage) and eruption (crisis stage) were projected in the classroom. A date and clock was used to help the scenario unfold. These dates were embedded in the video and audio clips to help participants become more immersed in the developing situation.
The simulation exercise tackled four crucial phases: Phase A - Pre-eruption, 6 months before the eruption; Phase B - Pre-eruption, 2 weeks before eruption, Phase C - Volcanic eruption in progress and Phase D - Post-eruption and the recovery process. Students were expected to communicate with a range of stakeholders e.g. provide situation reports, SETREPs, as well as respond to queries, provide relevant information as requested, and write press releases for line managers to distribute to the media, whilst at the same time adhering to communication protocols (see Figure 5) and making decisions in a timely manner. Student groups were assigned to different geographical sectors around the reference area (Mount Somma-Vesuvius) but they were encouraged to communicate with each other (phone, email, Yammer). All responses were captured, digitally, and participants encouraged to reflect upon and discuss their performance.

Figure 6. Students using GIS for hazard evaluation and decision making during simulation exercise.

3.5. Methodology: Evaluating students perception of their risk communication skills
Questionnaires and a focus group were used to evaluate the student's perception of how well their risk communication skills had developed (see Section 4). The questionnaires explored how students' perceptions of their CERC skills differed before and after the simulation as well as their level of motivation linked to the CERC exercises, how these exercises enhanced their learning and what limited their learning.
The first section of the questionnaire explored how students perceived the CERC activities overall with questions such as *'what is your overall impression of the risk communication exercises'*. These were followed by questions exploring the impacts of individual phases of the CERC simulation. Most questions explored the perceived level of skills before and after each phase of activity and any factors that may have affected their engagement with the task. Finally, the questionnaires inquired if (and how) the activity encouraged learning. Questions requested responses against a scale of 1-5 (e.g. 1= not motivated and 5 = highly motivated).

The first questionnaire survey was done at the start of the module, before students were exposed to the CERC exercises, then prior to the simulation exercise (see Sections 3.2 & 3.3) and, finally, after the simulation exercise (Section 3.4). To track each student's progress, each was given a unique identifier number.
An independent researcher (non–teaching staff) then conducted a focus group meeting with student volunteers. The use of an outsider to conduct the focus group helped ensure that students felt free to express their views without the perceived influence of tutors and those directly involved in the simulation exercise and its assessment. The focus group explored key themes identified from the questionnaires and provided qualitative data about how the CERC tasks influenced their development of risk communication skills. Themes explored included: the level to which the students were developing their CERC skills, how the risk communication task motivated them to learn, their perceived improvement at different levels, any challenges experienced and any improvements that needed to be made. The key findings from the surveys and focus groups are summarised in Section 4.

4. Results- Evaluation of student's learning and confidence in communicating risk

As the aim of this paper was to evaluate the development of CERC skills amongst a group of students studying Natural Hazard management at an undergraduate level, analysis was undertaken to determine engagement with tasks, level of perceived improvement and the impact on learning.

4.1. Engagement with Risk Communication Strategy

First, students were asked: "*what is your overall impression of the risk communication exercises?"* The students asked to suggest three words that summarised their experience. The response was overwhelmingly positive, with students indicating that they found the simulation realistic. For example, one student commented *"exciting, it was as though we were in the field"*. Students appeared to appreciate the fact that CERC communication is challenging and that a high level of uncertainty is involved. Student comments highlighted this general awareness: "*the exercises have given me an insight into the chaos and ultimate disaster that can prevail if there is no organisation"* and *"helped increase my awareness regarding challenges faced when providing information to different people, and how the information needs to be tailored to suit the needs of different people e.g. the public"*.

Figure 7 displays the 138 responses visually as a word cloud, which is a *"useful tool for preliminary analysis"* (McNaught & Lam, 2010, p.630). Visual evaluation shows that most common words used by students to describe their experience were 'interesting', 'exciting' and 'interactive'. A key aim of the staff developing the exercises was to ensure that students engaged by finding these activities interesting and exciting (Ferrari & Mahalingham, 1998; Hmelo-Silver, 2004). Student enjoyment provides a "hook" that can be built on by educators and it can play a *"critical role in sustaining motivation and translating it into higher-quality cognitive engagement"* (Fredricks, 2014, p.86). This is reflected in comments such as: *"the diversity of needs, which is required by all people in society to effectively deal with a crisis scenario"; "that you need to decide the times of each response accurately and that communication needs to reach all bodies but most importantly the public*" and finally, simply, *"I have leant so much about the right approach to risk communication"*.

Less prominent in the word cloud (Figure 7) are indications that learners considered the exercises 'innovative' and 'useful'. However, there was very little negative comment apart

from dissatisfaction with the 'malfunctioning' of the communication tool (Figure 8). This may be related to difficulties experienced when using the university's computers for exercises. These sometimes 'froze' due to slow network connections and the volume of information being transferred. One student commented, *"It didn't really help, it wasn't functional in the right places/ times to be the most use"*. Whilst the underlying reason for this comment is unclear, it may be due to a combination of early schedule classes as a well a Geoscience students' preference to engage with more physical 'volcano processes' especially when in the field, rather than CERC. This may be resolved in future by a shift in the balance of the delivery.

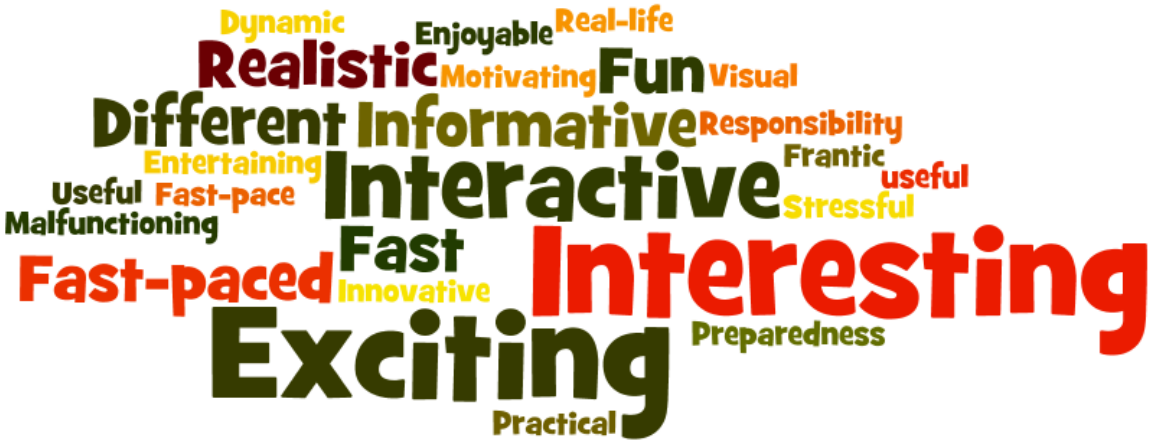

Figure 7. Students response when asked to provide three words to summarise their view on the risk communication exercises undertaken (n = 138)

4.2 Progression in the development of risk communication skills

Before undertaking the simulation exercise, students were asked to rate their own CERC skills, on a 5 point scale ranging from outstanding through excellent, good, average, and limited to weak. This scale corresponds with that used in all assessment feedback and also coincides with the university's academic assessment class boundaries, so it provides some benchmark for students trying to rate their own CERC skills.

Before the simulation exercise, most students (73%) ranked their CERC skills as average or below. About 26% described themselves as having good or excellent communication skills, although no one rated their skills as outstanding (see Figure 8)

After the risk communication exercises were completed, there was a noticeable change in the distribution of responses. Now, all students ranked themselves as average or above (see Figure 8). Over 67% ranked themselves as good compared to 13% before the CERC exercises. There was also an increase in those who rated themselves excellent communicators, 20% after compared to 13% before (see Figure 8). This perceived improvement in CERC skills is reflected in some student comments. These include; "*Helped*

increase my awareness regarding challenges faced when providing information to different people, and how the information needs to be tailored to suit the needs of different people e.g. the public" and "*Very good exposure to a 'real time' emergency. Helps give an understanding of the actors involved".*

However, even by the end of the exercises, none of the students considered themselves outstanding CERC communicators in all areas. This may be due to students recognising that, during a crisis, CERC can be challenging and that their skills need further development. As one student said: "*It has helped me understand the co-ordination involved and the speed with people must make the right decision (something we didn't seem to be very good at!)".* Even so, overall, most students believed the exercises greatly helped them to develop their CERC skills and, as one student states, *"[the simulation] helped me to understand the importance of risk communication".*

Figure 8. Students perception of the level of their risk communication skills before and after the simulation exercise (n= 46).

Whilst the results (Figure 8) indicate that students believe they improved their CERC skills overall, it was clear that there were some areas within the three phases of activity in the simulation where some students were developing their skills more than others. Such knowledge, of course, is useful for the further development of these CERC exercises. Accordingly, students were asked to rank their CERC skills after completing each of the major risk communication tasks (Sections 3.1, 3.2. 3.3). These tasks linked to communicating risk based on: hazard mapping and identification (Risk Identification Phase), communicating risk to a range of stakeholders, including the general public (Pre –crisis phase), and, finally, communicating during an ongoing crisis (Crisis Phase). When students were asked to rate their own CERC skills for each phase, over 30% rated themselves as having outstanding skills related to risk identification and mapping, 16% for the Crisis phase and 12% for the Pre-crisis phase. Not one student believed they were excellent CERC communicators across all phases. These results are not entirely surprising as risk mapping, interpretation and presentation of findings are skills the students have been exposed to since their first year undergraduate studies on the Natural Hazard Management programme. Inevitably, students felt more confident in such matters and, hence, more rated their skills as outstanding with a cluster of responses in the good to excellent range (Figure 9). For the Pre-crisis phase, responses are much more varied and there is a wider range of responses. The spread of responses at this phase may reflect a lack of confidence in their CERC skills. The spread is even wider in the Crisis phase with values ranging from weak to outstanding. More students felt less confident as the simulation progressed into its Crisis phase. When students rated their CERC skills in the Crisis Phase, almost 57% rated themselves either weak or average. Of course, the CERC exercises linked to the Pre-crisis and Crisis phases are relatively new experiences and, understandably, students felt less confident in their abilities .
So, there are students who rate themselves as excellent/outstanding in each phase of the CERC communication cycle but none for all three stages. Students who felt confident in one area often feel less confident in others. This relationship was tested statistically, against the Null Hypothesis: *There is no difference in student's perceived skills across risk communication tasks*. The results of a Pearson Correlation (2-tail) test clearly indicate that there are negative, but significant, correlations between students who rate themselves as outstanding CERC communicators at the Risk Identification phase and those at the Crisis

phases (Table 1). On the other-hand, there is a positive correlation between those who rate themselves highly in the Pre-crisis and the Crisis Phase.
The fact that different groups of students ranked themselves as excellent to outstanding in one set of CERC skills and not in another may be related to the students having different (often multiple) learning styles such as visual, auditory, reading and kinaesthetic (Fleming, 2001). As such, it is important that assessment tasks accommodate these different types of learners. The questionnaire data indicates that students who rate themselves outstanding during Crisis communication are more likely to rate themselves as average for communicating Risk Identification information. The opposite is true for those students who rate themselves outstanding in CERC Risk Identification. Two respondents, who rate themselves outstanding for Risk Identification but only average for risk communicating in a Crisis, comment: *"It has helped me understand the co-ordination involved and the speed with people must made the right decision (something I didn't seem to be very good at!)" and "Crisis management is stressful*".

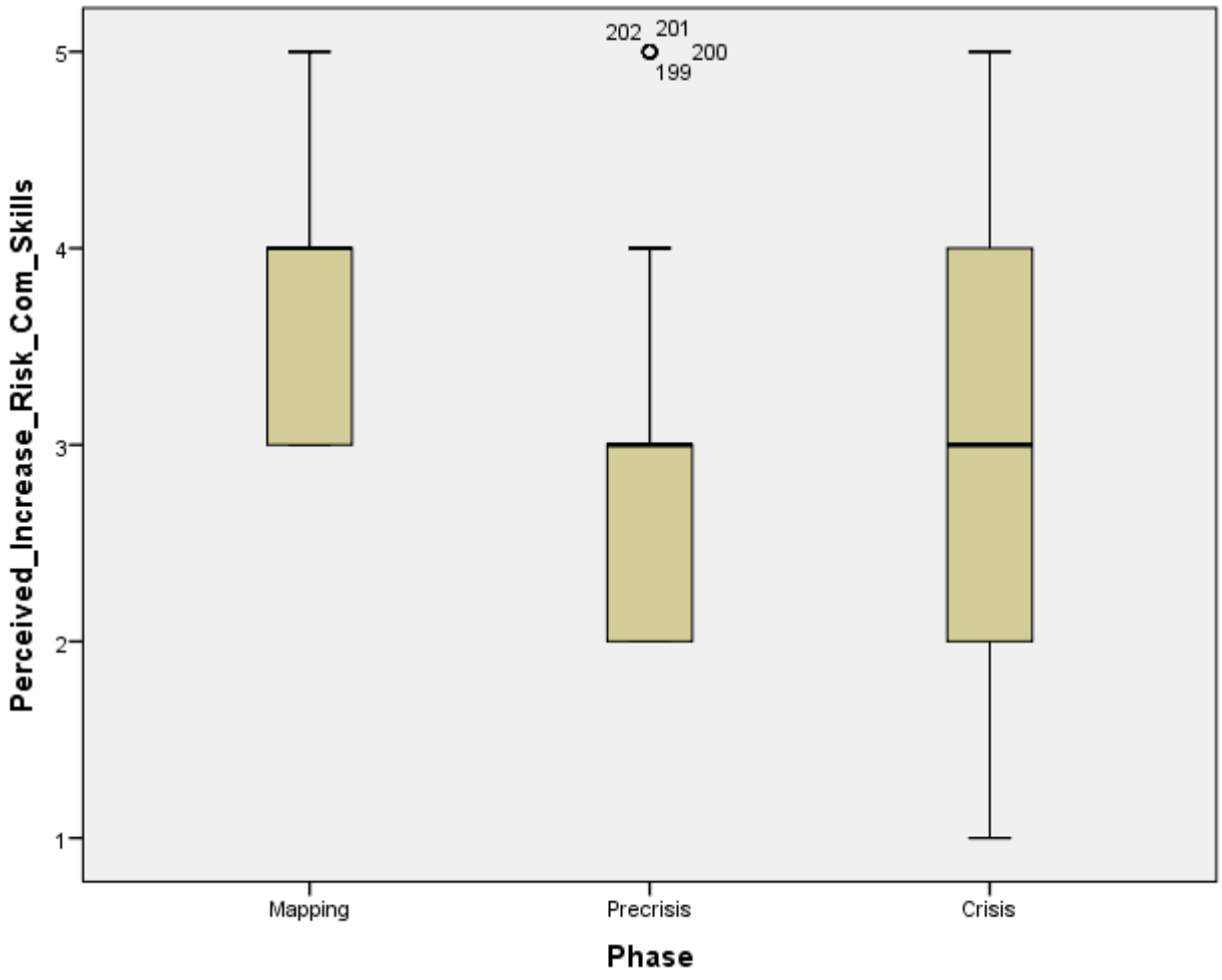

Figure 9. Perception of the development of risk perception skills in different phases of the exercises On the Y Axis, 1 = Weak, 2 = Average, 3 = Good, 4= Excellent, 5= Outstanding.

Table 1. Pearson Statistical analysis to evaluate the relationship between the main risk communication tasks given to students (see Sections 3.1- 3.3)		Communicate risk mapping	Communicating pre-disaster	Crisis
Communicate risk mapping	Pearson Correlation	1	-.262	-.489**
	Sig. (2-tailed)		.079	.001
	N	46	46	46
Communicating pre-disaster	Pearson Correlation	-.262	1	.745**
	Sig. (2-tailed)	.079		.000
	N	46	46	46
Crisis	Pearson Correlation	-.489**	.745**	1
	Sig. (2-tailed)	.001	.000	
	N	46	46	46

4.3. Enhancing learning and motivation

This research aimed to explore if the CERC exercises, particularly the use of technology motivated students to learn more about the topic and if so which exercise is successful and why. A plethora of research has analysed the benefits of using technology to solve pedagogic problems (e.g. Miller & France, 2013) and enhance student motivation and/or engagement (e.g. Latham & McCormick, 2007; Bolliger et al., 2010; Junco et al., 2011).

When students were presented with the statement *"the risk communication exercise motivated me to learn more"* less than 7% disagreed while approximately 89% either agreed or totally agreed and just 4% could not decide (Table 2). When asked whether it motivated them to learn, 100% of the students agreed that the CERC exercises motivated them to learn more, generally, and, specifically, about disasters (Figure 10). However, while 75% of students agreed that the exercises motivated to learn more about CERC, only 25% indicated that these CERC exercises motivated them to work harder.

Additionally, this research wanted to explore if there was link between motivation and the grade students achieved for their CERC written assignment - *'Development and critique of a risk communication strategy for the Naples Metropolitan region, Italy'*. Research (e.g. Khoshnevisas et.al, 2014) has shown that students who undertake problem-based learning exercises are more likely to be motivated to learn than those taught solely through lectures. The CERC exercises presented were highly problem-based, requiring students to evaluate data and develop a risk communication strategy. Using technology and problem-based simulation exercises can be a motivator for students while increased motivation may be linked to better performance (Latham & McCormick, 2007; Schultheiss, 2001).

This relationship was tested using a Pearson Correlation. The Null Hypothesis employed was: *There is no relationship between motivational level and grade obtain for risk communication assessment task*. Results show a significant relationship ($p < 0.01$) between motivation levels and grade achieved (Table 3). Contrary to the null hypothesis, there is a significant relationship between student motivation and the overall grade they achieved. A second Pearson Correlation was undertaken to evaluate the Null Hypothesis: *There is no relationship between individual risk communication phases, motivational level and the grade achieved*. Results indicate a positive correlation between those who are motivated by Phase 1 (see

Section 3.1; Table 3) and grade achieved. However, students who were highly motivated by Phases 2 and 3 (Section 3.2) achieved lower grades, a negative correlation. This could be due to the style of assessment. In this case, the CERC simulation was assessed by a written report, which lent itself better to those students that were stronger in analysing maps and writing reports (see Section 3.1). So, it is obvious that, in future, assessment tasks should be developed to assess better those students who are more capable verbal communicators and who thus thrive in the Pre-crisis and Crisis phases.

Table 2. Response to the student survey statement: 'these exercises motivated me to learn more'.

Motivational levels	**Responses (%)**
Totally disagree	4.3%
Disagree	2.2%
Can't decide	4.3%
Agree	10.9%
Totally agree	78.0%

Figure 10 Students response to the question regarding '*how the risk communication exercises motivate them to learn*.'

Table 3. Relationship between grades obtained for the CERC exercise and students' perceived level of motivation.

Correlations

		Grade	Motivation
Grade	Pearson Correlation	1	.462**
	Sig. (2-tailed)		.001
	N	46	46
Motivation	Pearson Correlation	.462**	1
	Sig. (2-tailed)	.001	
	N	46	46

**. Correlation is significant at the 0.01 level (2-tailed).

5. Discussion

It is important that students working in risk management develop effective CERC skills to better equip them for the work place. Here, a CERC simulation exercise has been developed for a final year module on a Natural Hazard Management programme. These CERC exercises involved risk mapping and communication, hazard perception assessment and crisis communication during a simulation exercise. To explore the benefits of this exercise, students were required to rate their own progress in developing CERC skills.

These results confirm that the CERC exercises motivated them to learn more about, not just risk communication, but natural hazard management as a whole. Students specified that they

had enjoyed and been engaged by the use of Web 2.0 technology within the simulation exercise. This is in agreement with a growing number of practitioners, such as Weller (2013). Okoro et al., (2013) reports a more general improvement to the teaching and learning experience when technology was utilised. Seale (2006) found that the technology was favoured, especially, by visual learners as it plays to their strengths in terms of visual and auditory capabilities. The integration of Web 2.0 technology into the CERC clearly illustrated the capacity of this technology to provide an authentic learning and communication environment. The success of this CERC learning activity is due in part to its authentic character, which is one of a number of critical success factors for successfully implementing Web 2.0 technology identified by Herrington & Herrington (2007). Moreover, this Web 2.0 activity supports Laurillard's) recommendations on the successful implementation of M-technologies in that *"To get the best from the experience the complexity of the learning design must be rich enough to match those rich environments"* (Laurillard, 2007, p. 174).

Students, in general, perceived that the range of activities provided by this CERC exercises enhanced and motivated their learning. In particular, the students found the exercises to be realistic and widely relevant to hazard management. However, to better quantify the progress with these students, a variety of assessment tasks are needed including written, verbal, visual and practical to cater for different learning styles (e.g. Fleming, 2001). Students also require a balance between such CERC exercises and the study of hazard processes; it is important to get the balance right. This study confirms that, generally, the CERC simulation exercises motivated students to learn and that they found such exercises engaging, despite some concerns (Section 4.1). Hopefully, the exercises have helped its participants develop as better risk communicators.

5. Conclusions

Having experienced the CERC simulation exercise:

- students believe their risk perception skills improved overall. However, these skills were more developed for tasks linked to risk mapping and risk perception but less so for crisis communication. Students who indicated that their risk communication skills were average to good before the CERC exercises were more likely to rank themselves as excellent crisis communicator afterwards but less confident about communication skills linked to risk mapping. These students were also more likely to under-perform in the written assessment. This is likely because the assessment task does not align to these student's strengths in spoken communication.

- One significant finding was that, generally, students placed themselves in two mutually exclusive categories of CERC communicator: communicator of scientific information (e.g. mapping) and Pre/During Crisis communicator. This has far-reaching implications for engaging students when developing their communication skills. It clearly indicates different learning styles for each group and may also indicate students' preferences for the risk communication field where they will aim to progress.

- Overall, the risk communication exercises played an important role in increasing learners' confidence in their CERC skills and they gained a more in-depth understanding of the requirements of effective and timely communications should they need to develop a CERC strategy during a crisis.

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