

# Towards a Capability Model for Emergency Training Improvement

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## ABSTRACT

Giving adequate attention to training personnel within an organization to perform an activity of any kind determines its success or failure. Training in emergency management is a key point and the participants must have adequate preparation for each activity they carry out. The different activities in each emergency management phase generate the appropriate training according to the role performed by stakeholders. The training is provided through techniques and IT support tools that consolidate the knowledge imparted by the trainer. This paper describes the initial steps in creating a capability model to support the training of stakeholders and ensure the effectiveness of the response teams, as well as the appropriate actions of workers and citizens in an emergency. Knowledge is consolidated through training, evaluation and feedback from practice. The proposed model is being integrated in the QuEP framework to guide organizations in assessing and improving the management of their emergency plans.

## Keywords

Capability Model, Training, Emergency Management, Stakeholders, QuEP.

## INTRODUCTION

Emergency training methodologies evolve somewhat later than significant changes in educational methodologies. The training is initially focused on developing the response team's skills. At present, training for emergency management is aimed at developing capacities to respond to emergencies adequately or prevent disasters; it is essential to understand the causes of disasters, risk analysis, and response procedures. The causes of disasters must be analyzed to find the different factors that determine threats and vulnerability conditions (Ferradas et al., 2006).

Appropriate training of participants is of vital importance in all emergency management phases. Although there are general techniques and dynamics for training and improvement of skills (Suixiong P., 2009), we think that customized training in the field of emergency management is essential for organizations. Emergency management should be customized for each of the participants involved in each stage, so that investment in training for emergency management benefits both the person who receives it and the organization that trains them, which will be better prepared to deal with an emergency (or incident). Likewise, the support of Information Technologies (IT) tools in training is important for the continuous improvement of disaster prevention, emergencies, and reconstruction. The main problem is how to improve the training of the people involved in emergency management. Currently, the training is mostly theoretical or based on the experience of the stakeholders, and an evaluation with the corresponding feedback is not carried out after a training. In addition, the use of IT tools to

support training, reduce the high costs of drills and make it possible to apply the evaluation/feedback techniques to improve the training.

This paper proposes a capability model for organizations to define the customized training of all the stakeholders in each stage. This capability model establishes the guidelines to be followed in order to plan, train, validate, evaluate and obtain feedback from the training in an iterative manner, thus achieving the continuous improvement of the stakeholders teaching-learning process in emergency management. This process will be supported by IT-tools.

The paper is organized as follows: Section 2 reviews the main concepts related to emergency management, training techniques and the dimensions of training involved in emergency management. Section 3 describes our proposed emergency management capability model, and Section 4 concludes the paper and outlines further research.

## TRAINING FOR EMERGENCY MANAGEMENT

The knowledge acquired in training helps people not only to improve their knowledge but also to face emergencies or situations that arise unexpectedly. In fact, to avoid obsolescence of knowledge, periodic training should be carried out as recommended in the training plan. According to Strube (Strube et al., 2011), a training plan is based on activities that can help in collecting information about prospective new systems and the support of resource investments. The training content must contain theoretical information, experiences, and practices (Xing et al., 2010). Other authors, such as Das (Das, 2018), indicate the learning objectives, specify the learning outcomes and the skill and knowledge to be imparted to the learner. Ferradas (Ferradas et al., 2006) indicates the need to identify the study domain from which the contents of the training plan must be defined. From our perspective, good training not only involves a set of activities to be carried out periodically but also includes learning objectives, so that we therefore introduce the concept of the capability plan, which includes both aspects.

Techniques and tools that support the capability process can be applied to implement a capability plan. For instance, Fernández (Fernandez, 2005) indicates that it is necessary to consider the objectives pursued, the participant or group, its maturity, its training, physical environment, psychological environment, and the trainer capacity. Different authors have proposed different training techniques. For example, Ferradas (Ferradas et al., 2006) defined techniques such as interviews, participant observation, life stories, surveys, discussion groups, participatory diagnosis and identification of roles. Suixiong (Suixiong P., 2009) identifies other techniques such as lectures on theories, demonstration and training, individual and group practices. In this work we use the training techniques defined by expert trainers in (Adibi, 2000), who identifies six techniques, including *on-the-job training*, *conferences*, *role-playing*, *audiovisual*, *programmed learning*, and *simulations*.

The *on-the-job training* technique consists of assigning new employees to the experienced workers or supervisors who are in charge of actual training. There are several types of this training, the best known being: direct instruction and rotation of the position. The *conference* technique is practical and easy to implement and is a quick and easy way to provide knowledge to large groups. It can be accompanied by printed materials to facilitate learning. The *Role-playing* technique is used to teach sales techniques, interview techniques, to address groups, resolve conflicts and achieve negotiations or hold positions of greater responsibility and consists of having the professionals carry out roles according to the position or tasks they perform. *Audiovisual techniques* are related to the presentation of information to employees through audiovisual techniques such as films, closed-circuit television, audio or videotapes. The *programmed learning* technique consists of presenting a set of questions or facts for the student to answer, then it reviews and compares the answers and repeating the questions with wrong answers until all have been answered correctly. This technique is effective because it gives the employee immediate feedback on the accuracy of his answers and on the learning he is achieving. *Simulation* is a technique in which employees learn in real or simulated equipment the execution of their tasks, for example, simulated handling of machines, vehicles or airplanes. This training corrects errors without actually placing the students in dangerous situations and is almost a necessity in positions where it is too expensive or dangerous to train employees directly.

As technology influences the effectiveness of the training contents and training programmes, the organization should plan and arrange such training contents for the participants to motivate and benefit them. For example, e-training provides many opportunities for business organizations and employee as learners (Singh et al., 2015). The various opportunities include effective use of IT, delivery of updated knowledge and technologies anytime, anywhere and to anyone, cost cutting of training and the just-in-time philosophy. Other tools simulate serious games, as explained in two case studies in Heldal (Heldal, 2016). The first case is a simulated evacuation of a ship on fire and the second case the simulator provides response training in a train crash.

In the emergency management field, the purpose of training is to develop local capacities to respond to unexpected events and/or to prevent disasters. For this reason, it is essential to start from an understanding of the causes of

disasters and their consequences, which takes us to risks analysis. Cause analysis is necessary to determine the different factors that constitute threats and vulnerability to the population.

Ferradas identified the training dimensions in areas such as *Education, Social, Technical, Legal and Institutional, and Economic*. *Education* deals with the risk management theory and planning for development, disasters and livelihoods, rehabilitation and reconstruction in the perspective of development and minimum standards for humanitarian aid. The *Social* dimension refers to the organization and leadership, ethics and values, memory and history of disasters, perceptions of risk, prevention and adaptation strategies, the prevention culture, information needs, communication media, informal communication, information networks and information campaigns. The *Technique* dimension is related to risk assessment, the preparation of risk maps, the use of databases for geo-referencing and geographic information systems, preparedness and emergency response plans, technologies for disaster prevention and emergency response, early warning systems, damage and needs assessment, psycho-social rehabilitation, operational emergency management and the implementation of temporary shelters. The *legal and institutional* dimension refers to the existing legislation applicable to disaster prevention and response, law and regulation of Civil Defense, local laws and state policies in emergencies, priorities, support systems and distribution of aid. Finally, the *Economic* dimension deals with the economic impact of disasters and the profitability of investment in disasters.

Our proposal to improve emergency management training thus begins by defining a customized capability plan, which should contain learning objectives, activities, and contents classified by dimensions, techniques and tools.

### CiET: TOWARDS A CAPABILITY MODEL FOR EMERGENCY MANAGEMENT

We have defined the capability model for emergency management, called the CiET model (*Continuous improvement for Emergency Management Training*). Our work is based on this model which allows customizing the training contents of each activity and emergency phase for each of the participants. The importance of optimal training translates into better resilience in emergency management, as well as reducing the number of victims and costs resulting from an unexpected event. The first step in building a capability plan is to identify the general parameters, such as the dimensions and techniques of the training, the phases, and activities of the emergency management and the expected learning objectives.

The second step considers the importance of the preparation of participants in emergency management. We based this on the Ferradas training dimensions and on the Fernandez techniques and expert trainers to define a capability model that emphasizes the customization of training contents for each of the activities of each phase, considering three phases: pre-disaster, response and post-disaster (Aline, 2009).

We identified the main contents that will be taught in the training process regarding the activities of the emergency management phases, as shown in Figure 1. In the *planning or pre-disaster* phase, participants should be trained to identify the type of emergencies, to identify means of protection, to know building structures, to know the emergency plan, to know the legal and institutional regulations of the organization, to detect crisis, to carry out risk analysis and to identify an alert (crisis alert). In the *response* phase, participants should be trained in vital issues such as knowing the evacuation routes, identifying signs and using fire extinguishers. The response team should also be trained to use communication and rescue equipment and to give first aid and to act efficiently until the return to normality. In the *analysis or post-disaster* phase, participants should be trained to provide psychological support to victims, analyze damage costs, to improve their resilience to disasters and to identify future risks.



Figure 1. Training in emergency management

The third step was to identify the participants in the capability process, for which we referred to the following classification: organization, planners, workers, responders and citizens (Núñez et al., 2015). In the capability process there are two identified roles, the *trainer* and the *learner*. Organization, planners and responders can play the role of trainer and all the stakeholders fulfill the role of learner. There may also be an external trainer, who is an expert in the subject to be trained and who is not part of the mentioned stakeholders. Table 1 defines the responsibilities of each of the stakeholders and their role in the capability process. The *trainer* is an active participant in this process; this role can be played by some of the stakeholders (organization, planners, response teams). An external expert may also be required, who should be a professional in the subject. The *learners* are all stakeholders trained in the capability process.

**Table 1. Stakeholders in the Capability Process (Based on Núñez et al., 2015)**

Stakeholders	Responsibilities	Capacitation role
Organization	Access to emergency management legislation. Plan registration. Validation. Education.	Trainer and learner
Planners	Plan design and generation. Notification of planning activities to the organization. Use of planning support tools.	Trainer and learner
Workers	Participation in the planning activities. Education and training.	Learner
Citizen	Access to plans. To follow the instructions of responders.	Learner
Responders	Access to emergency plan. Education and training. Response	Trainer and learner
Expert Trainer	Expert in a specific topic.	Trainer

The fourth step was to relate the stakeholders that participate in the training with the training content and dimension. It is important to be clear about the contents, the dimension to which they belong and the people who should be trained, since adequate training can reduce costs and improve the resilience (Penadés et al., 2017) of people in emergencies (see Figure 2).



**Figure 2. Dimensions, training content and stakeholders**

In the Educational dimension all the stakeholders are trained in contents of the pre-disaster phase (emergency types, emergency plan, crisis detection and crisis alert) and the response phase (evacuation routes, signs and first aid). In the Social dimension all the stakeholders are trained in contents of the post-disaster phase (psychological support for victims and resilience). In the Technique dimension all the stakeholders, except the organization, are trained in the contents of the pre-disaster phase (means of protection, building structures, risk analysis, the contents of response phase (fire extinguishers, communication equipment and rescue operations) and the identification of risks in the post-disaster phase. In the Legal and institutional dimension all the stakeholders, except the citizens, are trained in current legal regulations of pre-disaster phase. Finally, in the Economic dimension, the organization and planner must be trained in contents of post-disaster phase (analysis of damage costs, profitability of investment in prevention).

### CiET Capability Model

Figure 3 summarizes the proposed CiET capability model as a UML class diagram. A capability plan (represented by the *CAPABILITY\_PLAN* class) is a set of learning objectives (*LEARNING\_OBJETIVE* class) related to the phases of emergency management (*EM\_PHASE* class) with their respective activities (*EM\_ACTIVITY* class). The training contents (*CONTENT\_TRAINING* class) are specified in each of the emergency management activities, according to the dimension (*TRAINING\_DIMENSION* class) to which they belong. For each content one or more techniques (*TRAINING\_TECHNIQUE* class) and IT tools (*TRAINING\_TOOL* class) can be applied. Supporting the learning of the stakeholders (*STAKEHOLDER* class) of the organization (*ORGANIZATION* class) through evaluation (*EVALUATION* class) provides feedback and the continuous training of stakeholders.

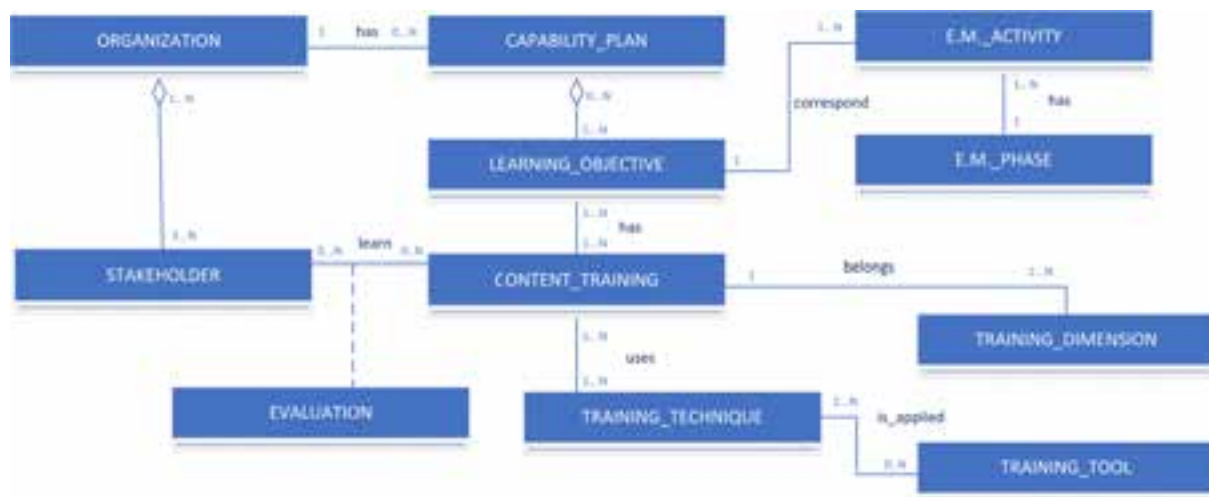


Figure 3. CiET Capability Model

An organization defines the customized capability plans of the stakeholders according to the learning objectives established in the selected emergency management activities. The most relevant aspect the capability plan is to evaluate the training contents and measure the fulfillment of the learning objectives established. If the training contents and learning objectives are not met, the training content should be reinforced, and the evaluation repeated to provide feedback to the learning process and redesign the capability plan if there are deficiencies in the contents or unreal learning objectives.

### Defining CiET capability plans

An organization will define their customized capability plans according to the CiET model. For instance, Figure 4 illustrates different capability plans for the learning objective “Evacuation Routes”. CiET Plan 1 is for citizens and CiET Plan 2 for responders. The CiET Plan 1 covers the educational dimension, and the CiET Plan 2 covers the technical dimension and the educational dimension. The trainer in CiET Plan 1 can be an expert trainer or a responder trained, but for CiET Plan 2 must be an expert trainer. Therefore, in CiET Plan 1, the contents are broader and deeper, and the techniques used in each content are more oriented to simulations, audiovisual and practical learning. Finally, it must be evaluated and provide feedback through conferences and IT tools that allow repetitive training and evaluation with comparative results to reinforce the shortcomings found and achieve the learning objectives set.

### Evaluation-Oriented Training

One of the main weaknesses of training activities and processes in disaster prevention and response continues to be the evaluation of such activities and the impact of the educational process in general. The evaluation may be related to a specific educational action or to the more comprehensive training process. The evaluation must be done in three stages of the training process. At the beginning, the training process is carried out to identify what knowledge or skills the participant has and adjust the training to the needs of the group (leveling). During the training process it is used to follow up the progress achieved by the participants. In order to assess the levels of knowledge of the beneficiaries and the effectiveness of the training methods, it is necessary to implement ongoing assessment programs during the training and, if possible, to implement any corrective measures. The final evaluation is the most frequently used and can verify whether a sufficient level of knowledge and skills has been reached.

CiET Plan 1		CiET Plan 2	
<i>Organization:</i>	Organization X	<i>Organization:</i>	Organization X
<i>EM Phase:</i>	Response	<i>EM Phase:</i>	Response
<i>EM Activity:</i>	Evacuation	<i>EM Activity:</i>	Evacuation
<i>Dimension:</i>	Educational	<i>Dimension:</i>	Educational, Technique
<i>Objective Learning:</i>	Evacuation Routes	<i>Objective Learning:</i>	Evacuation Routes
<i>Stakeholder:</i>	Citizen, Workers	<i>Stakeholder:</i>	Responders
<i>Trainer:</i>	Responder or Expert	<i>Trainer:</i>	Expert
<i>Content:</i>	<i>Techniques:</i>	<i>Content:</i>	<i>Techniques:</i>
Building's plan	Conferences, audiovisuals	Building's plan	Conferences, audiovisuals
Routes	Role play, simulations	Protocols	Conferences, practices
Signs	Audiovisuals, practices	Routes	Role play, simulations
Meeting points	Simulations, practices	Signs	Audiovisuals, practices
Restrictions	Conferences, audiovisuals	Meeting points	Simulations, practices
Prohibitions	Conferences, audiovisuals	Tools use	Conferences, role play,
Advices	Audiovisuals	Communication	Audiovisuals, simulations,
		Equipment use	practices
		Restrictions	Conferences, audiovisuals
		Prohibitions	Conferences, audiovisuals
		Advices	Audiovisuals
<i>Tools:</i>	Simulators, serious games, IT Tools customized	<i>Tools:</i>	Simulators, serious games, IT Tools customized

Figure 4. CiET Capability Plans

### Evaluation-Oriented Training

One of the main weaknesses of training activities and processes in disaster prevention and response continues to be the evaluation of such activities and the impact of the educational process in general. The evaluation may be related to a specific educational action or to the more comprehensive training process. The evaluation must be done in three stages of the training process. At the beginning, the training process is carried out to identify what knowledge or skills the participant has and adjust the training to the needs of the group (leveling). During the training process it is used to follow up the progress achieved by the participants. In order to assess the levels of knowledge of the beneficiaries and the effectiveness of the training methods, it is necessary to implement ongoing assessment programs during the training and, if possible, to implement any corrective measures. The final evaluation is the most frequently used and can verify whether a sufficient level of knowledge and skills has been reached.

Consequently, the key to evaluation-oriented training is feedback. We understand by feedback the answers and comments that are given to stakeholders after performing a training content or evaluation. Feedback has the potential to support academic achievement, promote motivation, self-regulation and self-efficacy, allowing stakeholders to reduce the distance between current performance and desired performance (Seel, 2012).

Feedback is a good way to determine the effectiveness of the training process and the degree of satisfaction of the stakeholders in order to have an accurate idea of what should be improved and where additional training may be necessary. It can be done at the end of each session or at the end of the training. The results obtained from the evaluation and feedback can measure the fulfillment of the learning objectives and achieve the continuous

improvement of the capability process and the CiET capability model.

Finally, the proposed CiET capability model is related to the improvement of the organization's capability. As the CiET model is the basis for defining a process of continuous and customized improvement of the stakeholders' training, it is not simply an isolated proposal to improve training in emergency management, but can be integrated into frameworks for improving emergency management, such as QuEP (Núñez et al., 2015). We are now working on integrating the CiET capability model into the QuEP framework – Level 5 (People) which assesses the participation of the people involved in emergency plans generation and enactment, principally via training and education activities (see Figure 5). This QuEP assessment includes a set of best practiques to improve in each level. The CiET model provides a solution to applied the QuEP recommendations and practices. The main aim of this integration is to obtain an integral and effective solution to improve an organization's emergency management and the capability of the stakeholders by providing customized plans, training techniques and tools, an evaluation process and feedback. The CiET Model can be applied to an organization after its evaluation using the QuEP framework to improve the level 5; the organization needs to implement a capability model for its human resource or for improvement the personal training in emergency management. The validation of the capability model will be done through training experiments to groups of stakeholders, according to QuEP. The experiments will be evaluated to obtain the feedback and apply the continuous improvement of the training and the CiET model.

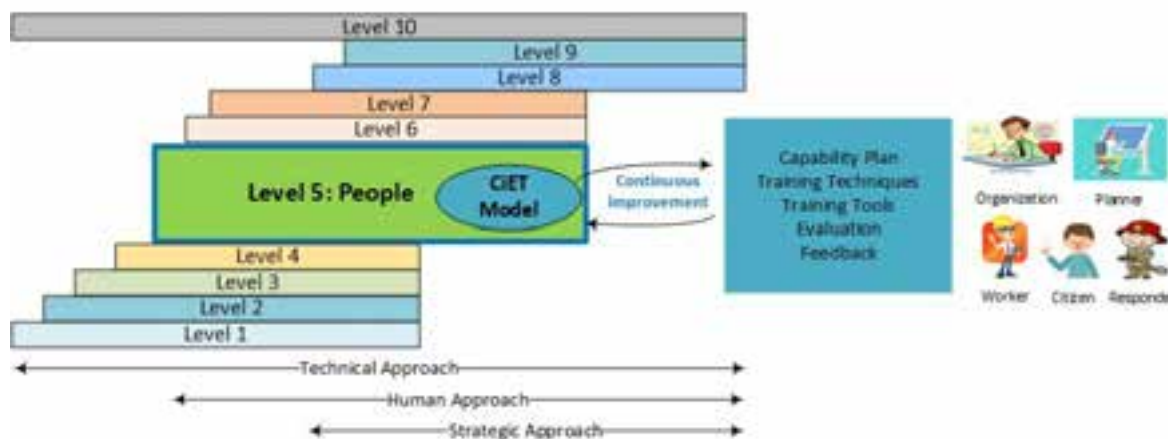


Figure 5. Integrating CiET Model with the QuEP framework (Based on Núñez et al., 2015)

## CONCLUSIONS AND FUTURE WORK

The CiET capability model proposed here can identify the elements and stakeholders participating in the improvement of training in emergency management. Training contents are customized and unambiguous for each stakeholder, which means that organizations are better prepared and trained, and the victims, damage and costs are reduced after an emergency. As work in progress, the CiET capability model is being integrated into the QuEP framework to improve emergency management in organizations. In future work, the CiET proposal will be expanded, not only to improve the model and validate it with real case studies, but to develop support and IT tools that support its implementation and implantation.

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## REFERENCES

- Adibi, M. M., "Bulk Power System Restoration Training Techniques," in *Power System Restoration: Methodologies & Implementation Strategies*, IEEE, 2000, pp. doi: 10.1109/9780470545607.ch39
- Aligne, F. Which Information and Decision Support System for the Crisis Management, *Information Systems and Technology Panel (IST) Symposium*. Bucharest, Romania, May 2009.
- Das S., "Cognitive Level Analysis in a Learning Cycle," *2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT)*, Mumbai, 2018, pp. 449-451. doi: 10.1109/ICALT.2018.00111

- Fernández, J., *Dinámicas de grupos y técnicas participativas*, Tarea, Lima, 2005.
- Ferradas, P., Vargas, A., Santillán, G. (2006) Ajzen, I. (1988) *Metodologías y herramientas para la capacitación en gestión de riesgo de Desastres*, Codex, Perú.
- Heldal, I., "Simulation and serious games in emergency management: Experiences from two case studies," *2016 22nd International Conference on Virtual System & Multimedia (VSMM)*, Kuala Lumpur, 2016, pp. 1-9. doi: 10.1109/VSM.2016.7863150
- Núñez, A.G., Penadés, M.C., Canós, J.H., Borges, M.R., (2015). Towards a total quality framework for the evaluation and improvement of emergency plans management. *Proceedings of the 12th International Conference on Information Systems for Crisis Response & Management (ISCRAM)*. Kristiansand, Norway.
- Penadés, M.C.; Núñez, A.G.; Canós, J.H. (2017). From planning to resilience: The role (and value) of the emergency plan. *Technological forecasting and social change*. 121, pp. 17 - 30. 2016. ISSN 0040-1625. DOI: <http://dx.doi.org/10.1016/j.techfore.2016.12.004>
- Seel, N. M. (Ed.). (2012). *Relevance Feedback Learning BT - Encyclopedia of the Sciences of Learning* (p. 2813). Boston, MA: Springer US. [https://doi.org/10.1007/978-1-4419-1428-6\\_5466](https://doi.org/10.1007/978-1-4419-1428-6_5466)
- Singh, H., Singh, B. P., "E-Training: An assessment tool to measure business effectiveness in a business organization," *2015 2nd International Conference on Computing for Sustainable Global Development (INDIACom)*, New Delhi, 2015, pp. 1229-1231.
- Strube C. M., Loren J. R., "Portfolio influences on Air Force Capabilities-Based assessment and Capabilities-Based Planning activities," *2011 6th International Conference on System of Systems Engineering*, Albuquerque, NM, 2011, pp. 83-88. doi: 10.1109/SYSOSE.2011.5966578
- Suixiong P., "Practice and Quest of the Teacher's Training in Educational Technique Ability," *2009 First International Workshop on Education Technology and Computer Science*, Wuhan, Hubei, 2009, pp. 780-784. doi: 10.1109/ETCS.2009.436
- Xing Y., Hu S., "Following Construction Study of One Village One College Student Training Plan in Heilongjiang Province," *2010 International Conference on e-Education, e-Business, e-Management and e-Learning*, Sanya, 2010, pp. 436-439. doi: 10.1109/IC4E.2010.46