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# Comparative Analysis of Cost-Effectiveness in Basic Life Support Training: Traditional Learning versus Distance Learning

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## Abstract

Cardiovascular diseases are one of the leading causes of death worldwide. Fact is that the successful treatment of such conditions requires, both the immediate detection - diagnosis of the (cardiac) arrest, and a rapid reaction to its treatment, with an immediate start of cardiopulmonary resuscitation. In order to achieve a rapid response at the scene of the incident, a specialized and mass education of citizens is imperative. The use of new technologies and Distance Learning is the spearhead in this attempt to deal with cardiac arrest incidents on the spot. The aim of the presented study is to calculate the training costs for both Traditional Learning and Distance Learning in Cardiopulmonary Resuscitation and to compare it, based on the most cost-effective training method.

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# 1. Introduction

In recent years is observed that non-communicable diseases (NCDs) continue to be one of the main cause of death (WHO, 2017b). Globally, the death rate is 17.7 million (WHO, 2017a). These diseases include Cardiovascular Diseases (WHO, 2017c), which have been implicated in the loss of 7.4 million people worldwide (WHO, 2017a). The highest rate of cardiopulmonary arrests, which reaches 92%, occur outside the hospital environment. It is a fact that the successful treatment of such conditions requires both the immediate detection - diagnosis of the arrest, and the rapid response regarding its treatment, with the immediate start of Cardiopulmonary Resuscitation (Straney et al., 2015).

To achieve such a condition, it is evident that immediate and proper reaction of those close to the victims of the arrest is required. With this in mind, it is also clear that, for this to be more possible, more people should be able to access Basic Life Support education/ training, even in remote areas. The solution is Distance Learning. In order to set educational policies, there should be a cost study to make it clear, which method is most cost-effective, by focusing on costs in relation to the effectiveness of each training program.

To be able to have an economic approach to teaching methods, it is essential to calculate the costs for each learning process separately. Certainly, the cost calculation and, by extension, its definition, is a particular issue, since there is a discrepancy between the researchers, mainly due to the use of different terminology regarding the factors affecting cost (Boettcher & Conrad, 2010; Rumble, 2001).

However, a basis for costing the creation of a training program for Traditional Learning can be summarized as follows:

1. Front End Analysis
2. Teaching design
3. Course design development
4. Creating forms
5. Study guide – Workbook development
6. Presentation files development and use of other visual media
7. Creation of certification – examination forms
8. Project management during educational planning
9. Review by the trainees – interested parties.

Correspondingly, cost data regarding a Distance Learning program can be summarized as follows:

1. Front End Analysis
2. Teaching Design
3. Storyboarding
4. Creating graphics
5. Video creation/use – Sound creation/use

6. Programming with the use of authoring tools
7. Quality Assurance Test
8. Project management
9. Review by the interested parties – trainees (Project assessment by the trainees).
10. Pilot study
11. Other costs (Chapman, 2010).

## 2. Aim

The aim of the present study is to calculate the training costs for both Live and Distance Learning regarding Cardiopulmonary Resuscitation and to compare it, based on with the most cost-effective training method.

## 3. Basic Terms

- **QCPR (Quality Cardiopulmonary Resuscitation):** Its name was given by the company Laerdal to characterize the ratings given by the software. The higher the percentage score, the more effective the cardiac resuscitation (CPR).
- **CPR (Cardiopulmonary Resuscitation):** It is a procedure that takes place in emergency states of arrest and combines chest compressions and rescue ventilations.
- **BLS (Basic Life Support):** It is a step - level of health intervention implemented on victims with life-threatening symptoms until special care, by specialized health care providers, is given.
- **MCQ (Multiple Choice Question):** It is a knowledge-based questionnaire structured by the ERC, in order to explore learners' knowledge.
- **ERC (European Resuscitation Council):** It is the European Resuscitation Council, which is responsible for certified education in Cardiopulmonary Resuscitation in Europe.
- **Mean depth:** The ideal mean depth of compressions during CPR performed to adults is set to 5-6cm
- **Mean rate of all compressions during this session:** The frequency of compressions for effective CPR should be 100-120 / min.
- **Ventilations:** It is the number of ventilations during CPR performance, with the ideal number being 5-6 ventilations/min.
- **Ventilations with adequate volume:** The ideal average air volume per ventilation is 400-700 ml.
- **Mean rate of all ventilations during this session:** The ideal number of ventilations is 6-12 ventilations per session (a session lasts 2 minutes).
- **CEA (Cost – Effectiveness Analysis):** Economic analysis focusing on the cost and effectiveness of two alternative programs with common objectives.
- **ICER (Incremental Cost – Effectiveness Ratio):** Marginal cost-effectiveness indicator. It is the final extractable result of a CEA analysis.

## 4. Material and Method

The basis of the educational process is the educational application called e-SaveLife. The application was created with the use of multimedia application creation tools, namely the Articulate Storyline2 program. An e-learning training program based on the Distance Education method was then built. The training platform used is the Modular Object Oriented Dynamic Learning Environment (Moodle). Moodle is an integrated open-source e-learning platform that contains all of the Learning Management System (LMS), CMS (Course Management System) and VLE (Virtual Learning Environment) (Karga, 2016). After the collection of the data, the two educational methods (Live and Distance Learning) were cost-assessed, focusing on the current socio-economic situation and the legislative framework governing the Greek State.

After the completion of the costing, a research study was carried out from October 2017 to March 2018, aiming at measuring the knowledge and skills of healthcare professionals in cardiopulmonary resuscitation. The exploration of the knowledge was carried out by answering a questionnaire of 20 multiple choice questions as developed by the official ERC program. The exploration of skills was carried out using a special model. The data were entered into a statistical data processing package, more specifically, the SPSS ver. 22 (Statistical Package for the Social Sciences).

The cost-effectiveness analysis was carried out using the ICER (Incremental Cost – Effectiveness Ratio) index

$$ICER = \frac{C1 - C0}{E1 - E0}$$

## 5. Results

After a statistical analysis carried out in 90 individuals (52.2% trained by Traditional Learning and 47.8% by Distance Learning), it was observed that Distance Learning trainees had a significantly higher score, ie greater knowledge, than those trained by Traditional Learning. In the sum of the correct answers of the participants, Distance Learning participants scored 95.2%, while their Traditional Learning counterparts scored 74.3%. Similarly, scoring on a percentage basis of the total skill scores as recorded by the software is 72.3% for Traditional Learning and 82.2% for Distance Learning. The results of both skills and knowledge do not have a statistically significant difference and are therefore considered to be equivalent.

The cost of the training programs calculated according to the parameters as defined by the international literature and incorporating economic data of the current socio-economic conjuncture.

At the same time, the aforementioned calculation was based on the training group of 25 individuals as an indicative number of trainees per program, with an average

number of training programs of 2 per training month, and an average number of 600 trainees per year for each program. On the basis of the above, it was found that the cost for Traditional Learning is 30.98 € per trainee, while for Distance Learning is 29.92 € per trainee.

By completing this cost-effectiveness analysis, we note that regarding the cost-effectiveness study of learning based on the level of knowledge, we have:

**Table 1: Knowledge cost-effectiveness analysis**

| | **Total cost (€)** | **Knowledge score** | **ICER*** |
|---|---|---|---|
| Traditional Learning | 30,98 | 0,743 | Dominated |
| Distance Learning | 29,92 | 0,952 | |
| *Incremental Cost-Effectiveness Ratio | | | |

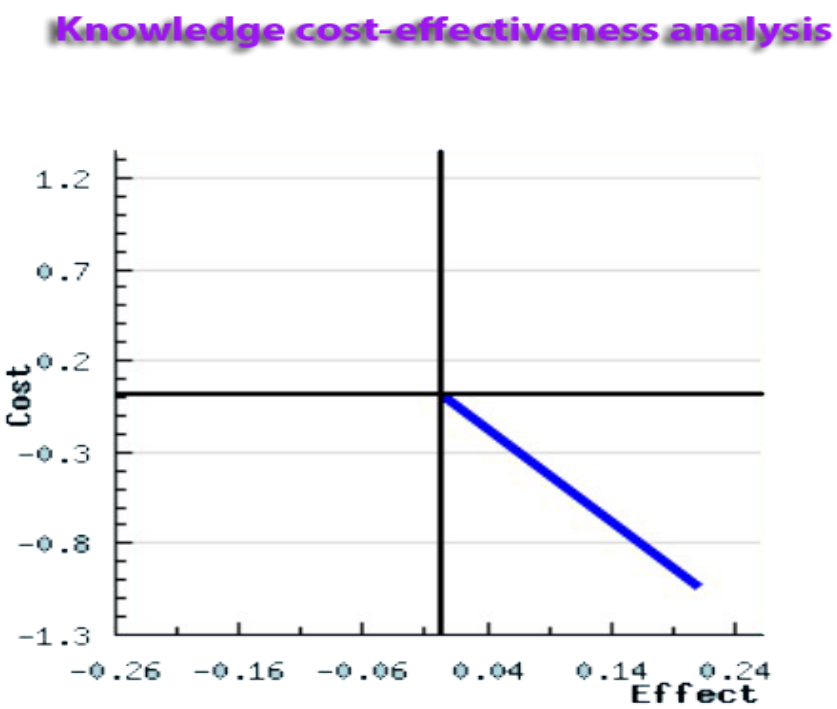


**Figure 1: Diagram of the Knowledge cost-effectiveness analysis**

Respectively, for the cost-effectiveness analysis of education based on the graded skills, the following results were obtained:

**Table 2: Skills cost-effectiveness analysis**

| | **Total cost (€)** | **QCPR Score** | **ICER*** |
|---|---|---|---|
| Traditional Learning | 30,98 | 0,723 | dominated |
| Distance Learning | 29,92 | 0,822 | |
| *Incremental Cost-Effectiveness Ratio | | | |

# 6. Conclusions

It is clear from the presented study that eLearning with the use of new multimedia technologies in Cardiopulmonary Resuscitation has similar effects on skill levels, as well as on the level of theoretical knowledge, compared to those of classic Traditional Learning (Chung, 2010; Moule, Albarran, Bessant, Brownfield, & Pollock, 2008).

It is also accepted by other studies that the use of preforms and software for recording skills has better educational results than the visual evaluation by the learners/ trainess, as it helps recognizing and limiting the skills mistakes that may exist (Gonzalez et al., 2017; Liberman, Lavoie, Mulder, Sampalis, 1999; Lynch, Einspruch, Nichol, & Aufderheide, 2008). The trainees manage to grasp the immediate feedback, studying the software parameters, their failures, and, thus, directly manage to improve the skills needed for a proper and effective cardiopulmonary revitalization.

A well-structured educational software and e-learning in general can have similar educational results to those of the classical methods of education/ learning (Mohd Saiboon et al., 2014; Moule et al., 2008) which of the two methods may be cost-effective. Such a study, with a focus on cardiopulmonary resuscitation, has not been realized at this time, perhaps because the data that are particularly taken into account for the creation of Distance Learning programs, including software development, involve many subjective characteristics and different terminology in terms of factors (Rumble, 2001); given this fact, each analysis uses a different cost design framework according to the textual features of each project (Boettcher & Conrad, 2010; Rumble, 2001).

All of the above may justify the absence of cost studies in Distance Learning in cardiopulmonary resuscitation. However, cost studies for Distance Learning, compared to Traditional Learning show, bibliographically, that Distance Learning is more economical than the Live one (Dawd, 2016; Geiger, LeBlanc, Hubik, Jenkins, & Carr, 2018; Xu, Jiang , Qin, Fang, & Hu, 2016).

Our study is based on the economic and social situation that exists in the given period in Greece, taking into account the financial data from the current reality. It is obvious that the cost of Traditional Learning is similar to that of Distance Learning, € 30.98 per person and € 29.92 per person, respectively; given, though, that the skills score for Traditional Learning at first recording is 72.3%, while for Distance Learning the respective score is 82.2%, we see that the cost-effectiveness is better for the Distance Learning training method. An explanation for this result could lie with the fact that the costs for logistics and mobility, as well as compensation for trainees, according to current legislation, are relatively high; moreover, the cost could be much higher, if the educational programs took place in remote areas of the geographical landscape of the Greek territory. Given that costing was done with the smallest possible expense in an urban area, it is clear that classical education is much more expensive for non-urban education, which should be added to the cost of movement, nutrition and housing of the training group. On the contrary, Distance Learning's key feature is that high costs are recorded during material creation and platform layout, and, therefore, are not repetitive. It is evident that by calculating the minimum number of people that can be trained per month (25 people per program with two programs per month) in one year, we see that the cost is set at € 29.92 per person. With this in mind, we can see that the cost of the program does not increase, regardless of the territory the learner is based on, but it is clear that there can be a significant reduction of cost per person, in cases where the programs will involve many more than 25 people per program, something that is possible in the tele-learning platforms, as individuals and groups of people, who are not necessarily in the same geographical area, can be trained simultaneously, while and not being required to train at the exact same time and place.

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