

Efficacy of Application of an Electronic Archive in the Rehabilitation Field: Education and Digital Testing of Professional Competencies of Learners

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Abstract. Objective: Evaluation of the efficacy of application of an electronic archive in the rehabilitation field – through digital testing of obtained professional competencies of learners.

Design: Comparison of results of traditional education and electronic learning, based on an electronic archive.

Results: We observed significant amelioration of professional competencies of learners of the experimental group and satisfaction of responders of the electronic archive and digital evaluation.

Keywords: Electronic Archive, Rehabilitation, e-Learning, Digital Testing.

1 Introduction

Today we observe significant changes in the health care delivery and in medical education. The roles of medical specialists and health professionals are evolving at a hurried pace. Practice is changing daily, with literally thousands of medical journals documenting our growing understanding of biological, social and clinical sciences (Frank, 2005). This information revolution requires the application of correspondent information technologies.

During last years, we perceive a rapid development of the preparation in the fields of Medicine, Public Health and Health Care in Bulgaria. Innovative elements are introduced in the educational process. We use multi-media power point presentations, electronic books and e-learning, considering the balance between theoretical knowledge and practical skills. We illustrate the educational material with clinical cases and use of modern devices (demonstrations in the hospitals and educational movies). We apply student-centered approach; elements of program-based learning; procedures for motivation of students' participation and students' investigations; contemporary methods of evaluation (for periodic control and final assessment).

In this context, the problem of calculation of competences is very important.

Richard J. Shavelson of Stanford University (2013) synthesizes the most popular definitions of competencies. He considers that competence involves: (1) a physical or intellectual ability, skill or both; (2) a performance capacity to do as well as to know; (3) standardization of the conditions under which performance is observed; (4) some level of standard of performance as “adequate”, “sufficient”, “proper”, “suitable” or “qualified”; and (5) improvement. Competence is the proper performance combining knowledge, skills and behaviour; adding standardization and improvement (Shavelson, 2013).

Many educators describe with skepticism the challenge in evaluating the so-called “difficult-to-measure” professional competencies of students in medical and paramedical professions – future medical specialists and health professionals. Some authors (Talbot, 2004) consider that graduate medical education is in danger of being subsumed in a minimalist discourse of competency. Many competency models follow the concepts of either academic competence or operational competence. According Talbot (2004), such criterion-referenced models must be replaced by a model that engages the higher order competence, performance and understanding, which represent professional practice at its best. Other authors (Kassab, et al, 2019) evaluate medical competencies, grouped under three main domains: cognitive, interpersonal and professionalism domains. Du et al (2019) identified essential profession-related competencies, clinical knowledge and skills that medical students should develop in the early stages of their education for future professional practice - according the opinion of faculty members. Statistical analysis of the experts’ opinions yielded four domains with items clustered as follows: interpersonal competencies (communication and collaboration), cognitive skills (problem solving, critical thinking and reflectivity), work-related skills (planning and time management) and professionalism (integrity, sense of responsibility, respect and empathy). All studies require reforms in the medical school curricula in an attempt to implement essential skills in medical students’ carrier.

There are some specificities in the field of education in physical medicine and rehabilitation in our country. Due to the interdisciplinary approach, in clinical rehabilitation practice in Bulgaria we have many medical specialists (physicians – specialists and trainees in Physical and rehabilitation medicine /PRM/) and health professionals (nurses, midwives; speech therapists; specialists in Kinesitherapy, in Medical rehabilitation and ergotherapy, in Medical rehabilitation and balneology). These particularities represent a challenge for the educators. On the other hand, students and trainees call for objectivity during the evaluation process. All these facts stimulated our motivation to realize a digitalization of educational materials and of measurement of individual and group competencies of members of the interdisciplinary multiprofessional rehabilitation team.

2 Objectives

Our goal was to measure the efficacy of application of an electronic archive in the rehabilitation field – through comparison of professional competencies, acquired using traditional education or through electronic learning (based on an e-archive in physical medicine, physical therapy and rehabilitation).

Our tasks include preparation of e-books; creation and validation of electronic tests for assessment of theoretical knowledge and practical skills of students and trainees; assessment of responders' opinion about the application of these e-books and e-tests.

3 Material and Methods

3.1 Design of the Study

We prepared electronic (e-) books in different rehabilitation fields (Koleva, 2019; Koleva, Yoshinov, 2019; Koleva, Yoshinov, Yoshinov, 2020; Koleva, Yoshinov, Yoshinov, Koleva, 2020; Koleva et al., 2020). All learners received e-books free-of-charge.

We applied these e-materials during the education of our students and trainees. On the base of the e-books, we create Internet-based tests for assessment of competencies of students and trainees. Finally, we applied these tests on 279 learners, divided into two groups (control group with traditional education and experimental group, using the electronic archive).

We created a bank of open and closed questions (one choice and multiple choice) in the field of rehabilitation, and we applied these questionnaires in the process of evaluation of undergraduate students (in Bachelor's and Master's degree) and of post-graduate students (medical doctors during the training in "Physical and Rehabilitation Medicine /PRM/").

Data of application of the e-archive (for current investigation) were collected in the period from September 2020 to May 2022 - during the education of students and trainees of the Medical University of Sofia and the Medical Faculty of Sofia University (where the second author is invited lecturer).

With the questionnaires (adapted to the correspondent level of competence), we realized periodic and final evaluation of students in different educational disciplines. The periodic assessment was done twice, after the end of principal modules (during the semester). The summative assessment of undergraduate students (bachelor's and master's degree) was realized by three tutors during a final exam – practical checkup and theoretical examination; accentuating on the cognitive domain.

Evaluation of medical doctors - trainees (during the specialization in PRM) was executed according the modules of the program of specialization, approved by the Ministry of Health of Bulgaria. This program is harmonized with the European requirements (Gutenbrunner, et al., 2007; European PRM bodies Alliance, 2018). *Basic modules* include: kinesitherapy, preformed modalities, hydro- and balneotherapy, peloidotherapy, thalassotherapy, prevention and rehabilitation. *Specialized modules* are oriented to PRM-methods, applied to different types of patients in the clinical practice of: neurologic and neurosurgical rehabilitation, orthopedic and post-traumatic rehabilitation, rheumatologic rehabilitation, cardiac and cardio-surgical rehabilitation, etc.

At the end of the respective educational course or module, we tested the learners' opinion on the efficacy of e-archive for professional competencies and for the corresponding exams (using a Likert scale). The target groups received questionnaires electronically (by e-mail) or directly (after the exam of the corresponding discipline, but

before the communication of results). This part of the assessment was anonymous (using the common e-mail of the group or course).

3.2 The Electronic Questionnaires

Our electronic questionnaires include open questions (requiring a brief answer), closed questions with one answer and multiple-choice closed questions. We apply open questions principally for definitions and for case studies. Multiple-choice closed questions were used frequently for specification of elements of physiotherapeutic algorithms. For all the other objectives, we put on one-choice closed questions.

We prepared electronic questionnaires for assessment of students' competencies in different areas and in different **basic educational disciplines**, as follows:

- **Kinesiological analysis** – of the spine and extremities, grasp, balance and gait;
- **Performed modalities** – treatment with electric currents and electrostatic field, magnetic fields, ultra-sound, inhalations;
- **Lasertherapy** – parameters for lasertherapy, laser-puncture and laser-acupuncture, indications and contra-indications;
- **Manual therapy** – manual tractions and mobilisations for all students, manipulations – only for medical doctors;
- **Ergotherapy** – ergo-analysis, assessment according the International classification of functioning, disability and health (ICF); assistive devices, prosthesis and orthosis;
- **Balneotherapy** – different mineral waters and peloids (therapeutic mud, fango, sea lye), physiological effects, methods of application, indications;
- **Thalassotherapy** – composition of sea water, physiological effects of ultraviolet and infrared sun radiation, sun baths, use of sea algae, speleotherapy, etc.

Specific questionnaires were oriented to the **special parts of rehabilitation**:

- ❖ **Neurorehabilitation** – bases of neurohabilitation, neurorehabilitation and neuro-ergotherapy; functional scales and methods for treatment; frequent neurological diseases and after neuro-surgical interventions;
- ❖ **Orthopedic rehabilitation** – basic principles of assessment and rehabilitation in patients with orthopedic diseases, traumatic conditions, after orthopedic surgery;
- ❖ **Cardiac rehabilitation** – bases of cardioprevention, control of risk factors, rehabilitation in cardiological diseases and after cardiac surgery;
- ❖ **Rheumatologic rehabilitation** – in arthrosis and arthritis.

Special tasks:

- ❖ **Case studies** – real-life situations, for examination of functional evaluation and rehabilitation complex for the concrete patient.

3.3 Material

The material of current study includes a total of 279 responders, distributed as follows:

- *bachelors and masters in “Kinesitherapy” (KT)*,

- *bachelors and masters in “Medical Rehabilitation and Ergotherapy” (MRET),*
- *masters in “Medical Rehabilitation and Balneology” (MRB),*
- *medical doctors (MD) – trainees in “Physical and Rehabilitation Medicine” (PRM).*

The responders were distributed in control groups (123 learners - traditional education and traditional exams) and experimental groups (156 responders - with electronic materials and electronic tests).

The following table 1 gives a summary of all tested students and trainees, by level of education:

Table 1. Distribution of responders (control and experimental groups).

| | Students | | | | | MD - trainees | Total |
|-----------------|-------------------|------|-----------------|------|-----|---------------|-------|
| | Bachelor’s degree | | Master’s degree | | | | |
| | KT | MRET | KT | MRET | MRB | | |
| Control groups | 49 | 27 | | 35 | | 12 | 123 |
| Plus e-learning | 53 | 42 | 11 | 22 | 23 | 5 | 156 |
| | 102 | 69 | 11 | 57 | 23 | | |
| | 171 | | 91 | | | 17 | 279 |
| | 262 | | | | | 17 | 279 |

The mean age of students in bachelor’s degree was 20 years (SD 1.2). The mean age of students in master’s degree was 25 years (SD 3.6) The mean age of medical doctors, trainees in PRM, was 29.6 (SD 2.5). The distribution of responders by profession and by sex is presented on figures 1 and 2.

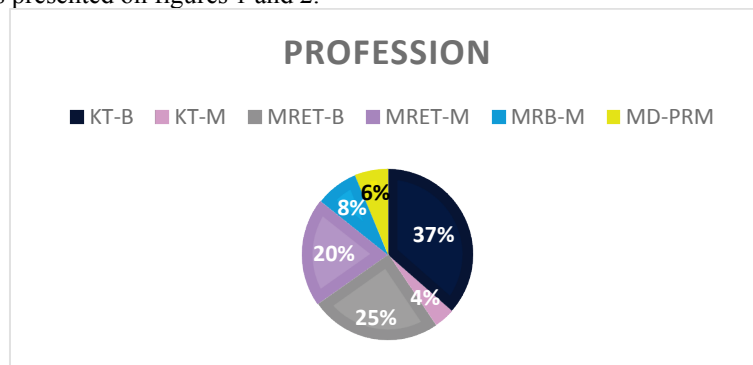


Fig. 1. Distribution of responders by profession / future profession

The distribution of responders by sex is presented on the figure 2 (89 males and 190 females).

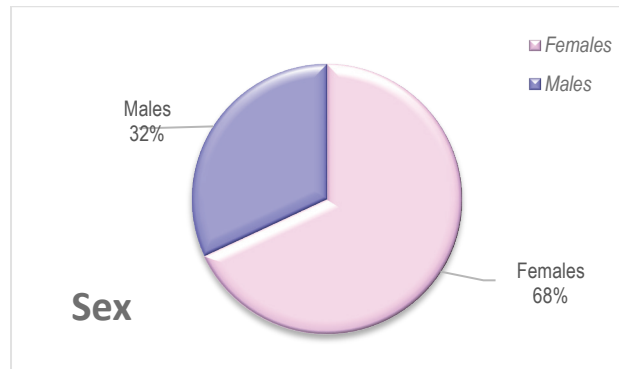


Fig. 2. Distribution of responders – by sex

3.4 Methods

The final statistical evaluation of results was prepared using the statistical package SPSS, version 19: options two samples comparison with parametrical analysis of variances ANOVA, t-test, Signed test, Signed rank test. For statistical significant effects we consider results with value of $p < 0.01$.

4 Results and Discussion

We observed significant amelioration of professional competencies of our students and trainees by the e-archive and satisfaction of responders of the electronic archive and of digital evaluation.

4.1 Evaluation of Basic Competencies of Members of the Responders

The complete evaluation is performed during theoretical and practical exams – at the end of every educational discipline. The notes in our country are between poor (2) and excellent (6). Figure 3 presents the distribution of notes (evaluation of principal bases of rehabilitation - theoretical knowledge and practical skills) in different members of the team: bachelors and masters, controls /C/ and experimental group /E/. The difference between control groups (traditional education) and the experimental groups (e-learning) is significant.

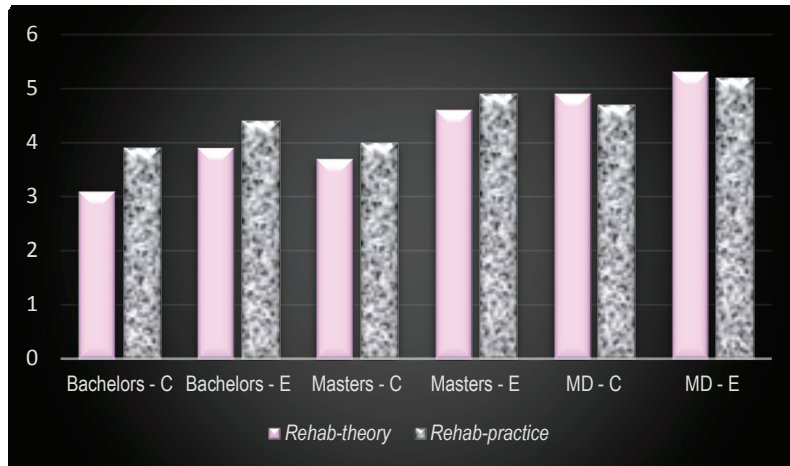


Fig. 3. Evaluation of competencies in the basic domains of rehabilitation (notes 2-6)

4.2 Evaluation of Competencies in the Fields of Special Rehabilitation

Next figure 4 presents the results of the evaluation of competencies in the fields of special rehabilitation (Reh/ Rehab): neurological and neurosurgical (Neuro-Reh), orthopedic and traumatologic (OT-Rehab), cardiac and cardiosurgical (Cardio-Reh), rheumatologic rehabilitation (Rheuma-Reh). Here we have data only of masters and medical doctors. The comparative analysis of results of control and experimental (ex-per) group demonstrated significant differences.

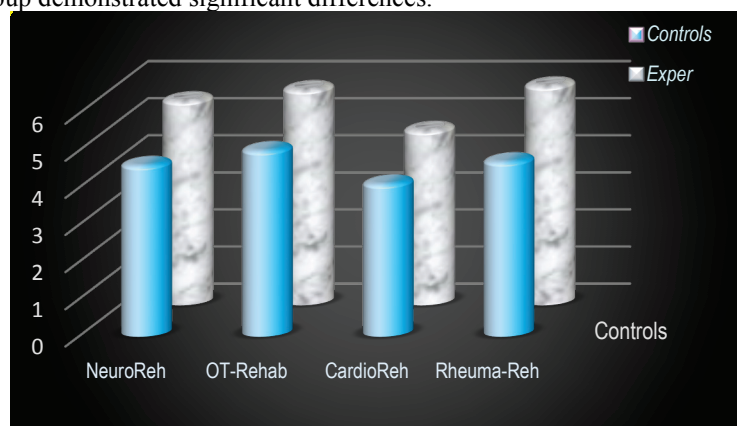


Fig. 4. Evaluation of competencies in special domains of rehabilitation (notes 2-6)

4.3 Analysis of Case Studies

The analysis of case studies is significantly better in experimental groups, especially of medical doctors – trainees in PRM. Results are presented in figure 5.

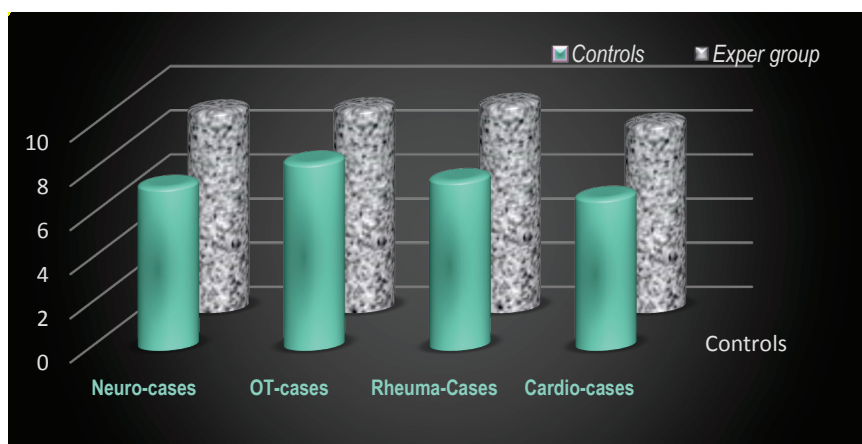


Fig. 5. Analysis of case studies - evaluation of competencies of MD-PRM trainees (notes 2-6)

Theoretical knowledge and practical skills of medical doctors are most developed in the fields of neurological and musculo-skeletal conditions. Cardiorehabilitation is not sufficiently presented during the graduate education of future physicians; probably this is the cause for insufficient knowledge in this field.

4.4 Learners' Opinion: Influence of the e-Archive on Competencies

Responders' opinion of the efficacy of the e-archive on professional competencies was analyzed using a Likert scale, presented in table 2 and figure 6. We applied a Likert scale (7 levels), with differentiation of effectiveness for the theoretical knowledge and for the practical skills.

Table 2. Answers of all 156 participants in the experimental group.

| Anonymous opinion | Number of responders | Percent |
|--------------------------|----------------------|---------|
| <i>Strongly positive</i> | 131 | 83,97 % |
| <i>Positive</i> | 17 | 10,90 % |
| <i>Maybe Yes</i> | 5 | 3,21 % |
| <i>Indifferent</i> | 2 | 1,28 % |
| <i>Maybe No</i> | 1 | 0,64 % |
| <i>Negative</i> | 0 | 0 % |
| <i>Strongly negative</i> | 0 | 0 % |
| <i>Total</i> | 156 | 100% |

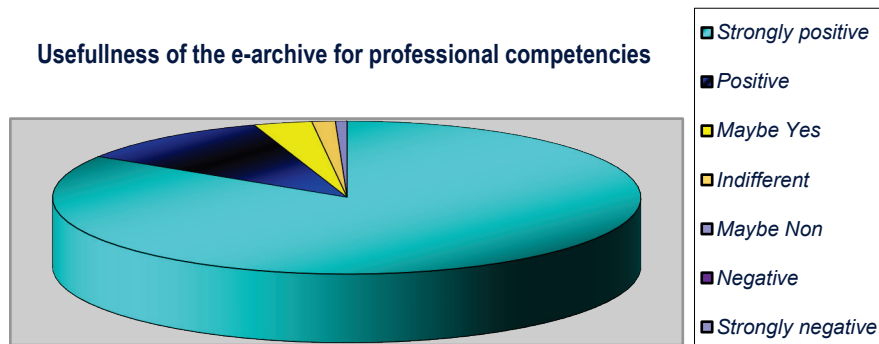


Fig. 6. Influence of the e-archive on professional competencies

4.5 Learners' Opinion about the Usefulness of the e-Archive for the Digital Evaluation

Next figure 7 presents the results of the fully filled anonymous questionnaires of all 156 responders of the experimental groups (students in bachelor's and in master's degree, medical doctors – PRM trainees) – usefulness of the e-archive for the theoretical exam and for the practical exam.

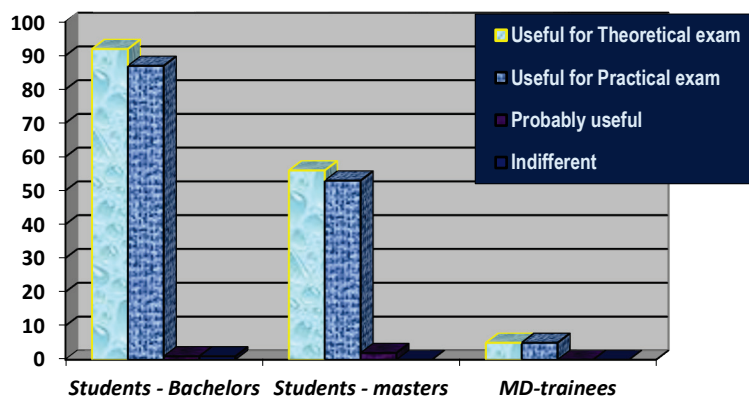


Fig. 7. Analysis of learners' opinion about the usefulness of the e-archive for the exams

Most of responders accept positively the electronic evaluation. They emphasized the objectivity of e-tests. Practically all students – bachelors consider that the e-archive is useful for the theoretical understanding and for their practical skills, and the respective exams. All students in master's degree (100%) and all PRM-trainees (100%) consider the e-archive useful for their theoretical expertise and practical abilities.

5 Conclusions

The comparison between traditional and electronic education (based on an e-archive) demonstrates the advantages of e-learning on theoretical knowledge and practical skills of members of the multi-disciplinary multi-professional rehabilitation team.

Bulgarian learners consider useful the electronic archive (e-platform).

The application of e-archive is convenient for the advance of cognitive elements of professional competences of our students and trainees.

In the future, we must include in the education (and, respectively, in the assessment) other competencies, related to professional behavior, as attitude, humanity, personal values, responsibility, etc. These are the possible directions for *upcoming research*.

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