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Evaluation of learning outcomes at the Nursing Department in the field of Evidence-Based Medicine with the use of an e-learning Moodle™ platform

Ocena efektów kształcenia studentów kierunku pielęgniarstwo z zakresu Evidence-Based Medicine z wykorzystaniem platformy e-learningowej Moodle™

ABSTRACT

Background. Despite the fact that the concept of Evidence-Based Medicine (EBP) is known and accepted by the specialists in the field of health sciences, study curricula realize this principle insufficiently, also when it concerns educating nurses.

Aim of the study. Comparative analysis of evaluating students using e-learning tools in the field of "Clinical research and basics of EBM" at the Nursing Department of the Medical University of Warsaw (MUW) between 2013/14 and 2014/15.

Material and methods. Two hundred and sixty-two students of post-graduate studies aiming at obtaining the second degree at the Nursing Department at the MUW, including 122 students from the year 2013/14 and 140 students from the year 2014/15. Snapshots representing the result obtained throughout the e-learning course credit, which covered 40 problem questions in total, were used.

In order to evaluate learning outcomes achieved by students in two subsequent years, a comparison was carried out of the final credits for both years and reliability of measurement was assessed. Interior compliance of the educational measurement was evaluated using an inter-correlation and multiple regression analysis.

Results. The degree of differentiation in scoring and reliability of measurement for both years was very similar (Leven's test, p > 0.05). However, it was observed that students from the year 2013/14 achieved statistically higher scores than those from the year 2014/15 (U Mann-Whitney test; p = 0.02; d-Cohen = 0.326). Moreover, for both years a similar score obtained in four modules in the field of practical skills was significantly correlated with the overall credit. The above dependencies were also confirmed in the regression analysis.

Conclusions. Empirical evidence presented in this paper that would support the efficiency of the didactic process based on e-learning tools allows to assume that the students of Nursing will certainly obtain the necessary competences in the field of EBM.

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Key words: distance education; Evidence-Based Medicine; Evidence-Based Nursing, educational measurement

STRESZCZENIE

Wstęp. Mimo że koncepcja praktyki medycznej opartej na dowodach naukowych (EBM) jest znana i akceptowane przez specjalistów nauk o zdrowiu, to nadal programy studiów w niedostatecznym stopniu realizuje tę zasadę, także w doniesieniu do kształcenia pielęgniarek/pielęgniarzy.

Cel pracy. Analiza porównawcza oceniania studentów za pomocą narzędzi e-learningowych w zakresie „Badań klinicznych i podstaw EBM" na kierunku pielęgniarstwo Warszawskiego Uniwersytetu Medycznego (WUM) w latach 2013/14 i 2014/15.

Materiał i metody. 262 studentów kształcących się w ramach studiów II stopnia na kierunku Pielęgniarstwo w WUM, w tym: 122 z rocznika 2013/14 i 140 z rocznika 2014/15. Wykorzystano dane punktowe stanowiące wynik uzyskany w toku zaliczenia e-learningowego obejmującego łącznie 40 pytań problemowych.

W celu oceny osiągniętych efektów kształcenia przez studentów z dwóch kolejnych roczników, porównano wyniki zaliczenia końcowego dla obu edycji oraz oszacowano rzetelność pomiaru. Wewnętrzną zgodność pomiaru edukacyjnego oceniono w jednowymiarowej analizie interkorelacji oraz wielowymiarowej analizie regresji wielorakiej.

Wyniki. Stopień zróżnicowania punktacji oraz rzetelność pomiaru dla obu roczników był bardzo podobny (test Levene'a, $p > 0,05$). Natomiast zaobserwowano, że studenci z rocznika 2013/14 osiągali statycznie istotnie wyższe wyniki, niż ci z rocznika 2014/15 (test U Manna-Whitneya; $p = 0,02$; *d*-Cohena = 0,326). Ponadto, dla obu roczników w podobnym stopniu punktacja uzyskana w zakresie czterech modułów umiejętności praktycznych była istotnie skorelowana z całkowitym wynikiem zaliczenia. Potwierdzenie powyższych zależności uzyskano także w analizie regresji.

Wnioski. Przedstawione w niniejszej pracy empiryczne dowody na skuteczność procesu dydaktycznego opartego na narzędziach e-learningowych pozwala zakładać, że powinien on zapewniać zdobycie przez studentów pielęgniarstwa niezbędnych kompetencji w zakresie EBM.

Słowa kluczowe: nauczanie zdalne; medycyna oparta na dowodach naukowych; pielęgniarstwo oparte na dowodach naukowych; ocena wiadomości

Introduction

David Eddy used the term "evidence-based" in 1987, in the context of planning health policy that would be based on scientific evidence obtained from population-based studies [1]. The term *Evidence-based Medicine* (EBM), coined in 1991 by the professor of medicine and clinical epidemiology, Gordon Guyatt, assumes systematic and consistent usage of verified, credible and current results of studies in everyday clinical practice, and eliminating activities of little efficiency and unjustified costs [2]. The term EBM was eventually "borrowed" by other clinical areas, such as nursing or obstetrics and, as a result, we may today talk about *Evidence-Based Practice* (EBP) in the selected groups of specialists in the field of health sciences [3].

In the curriculum of the second degree of studies of Nursing at Medical University of Warsaw (MUW), one of the subjects of general teaching is *Scientific Research in Nursing*. In the academic years of 2013/14 and 2014/15, this subject included a 6-hour thematic block concerning *Clinical Research and Basics of EBM*, which was realized in a multi-module e-learning course run asynchronously. The course was made available on the educational Moodle™ platform (Modular Object-Oriented Dynamic Learning Environment) (Moodle™ webpage of the Division of Teaching and Outcomes of Education at the Faculty of Health Sciences of MUW, http://www.nzd.moodle. wum.edu.pl/ [accessed 6 February 2015]) that is used to support distant learning (LCMS, Learning Content Management System).

The course *Clinical Research and Basics of EBM* comprised of seven thematic modules complemented with a list of literature references and a glossary: (I) What is EBM (Evidence-based medicine)? (II) Types and methodology of clinical research; (III) Evaluation of credibility of clinical research; (IV) Evaluation of articles concerning treatment, prognosis or harmfulness; (V) Evaluation of information about the diagnostic method; (VI) Secondary analysis of data: meta-analysis and systematic review; (VII) Guidelines for clinical practice. For every module, didactic materials were selected. These included, for example, fragments of literature with the lecturer's commentary, links to credible internet sites, films, radio programs and PowerPoint® presentations with explanations prepared by an academic teacher. Each thematic module was organized in a form of a *Lesson* and finished with a few sentences prepared in a form of problem questions as multiple-choice questions (MCQs). Individual topics created an educational path with forced transitions so that students would not be able to realize the modules in random order. A student could go to another module after they had performed obligatory tasks that were provided for a given topic. A condition under which an e-course could have been passed was obtaining a score of at least 51% in all performed tasks. During the time of the course, students had possibilities to consult the lecturer on-line both in synchronous mode (Skype™, chat), and asynchronous one (e-mail, forum).

The aim of this paper is to present the results of comparative analysis concerning evaluating students using e-learning tools in the field of *Clinical Research and Basics of EBM* at the Nursing Department at MUW between 2013/14 and 2014/15.

Material and methods

The studied group comprised of 262 students on post-graduate studies at the Nursing Department at MUW, including: 122 students from the year 2013/14

and 140 from the year 2014/15. Snapshot data were used in the analysis, which became the grade for a solved task prepared in the form of MCQs. The results obtained throughout the e-learning course covered 40 questions in total. To perform a test on-line, a *Quiz* tool that was available as part of Moodle™ e-learning platform was used.

In order to evaluate the achieved learning outcomes by the students in two consecutive years, final results for both years were compared. The significance of differences in the groups of students from the years 2013/14 and 2014/15 were evaluated. Levene's homogeneity of variance test and non-parametric U Mann-Whitney test were used for comparison. Moreover, for individual sets of test questions, reliability was evaluated using α-Cronbach coefficient and a standard error of measurement (SEM) was determined. To perform internal analysis of compliance of the measurement of the achieved learning outcomes, r-Pearson linear correlation coefficient was used. Inter-correlations were determined for the results obtained by candidates in ranges of individual topics (modules). Internal integrity of the final test was also evaluated using the method of multiple regression for five independent variables (explanatory): 1) academic year; 2) evaluation of articles concerning treatment, prognosis or harmfulness; 3) evaluation of information about the diagnostic method; 4) secondary analysis of data: meta-analysis and systematic review; 5) guidelines for clinical practice. Parameters of the function of regression together with evaluation of standard errors were evaluated and the standardized β coefficient was established so as to determine the force of influence of independent variables on the total score of the e-learning course (dependent variable, explanatory) [4].

In calculations, the STATISTICA statistical package, version 12 was used (StatSoft, Inc.) in compliance with the MUW license. For all analyses, $\alpha = 0.05$ was assumed an *a priori* level of relevance.

Results

The comparative analysis of equinumerosity for both of the studied groups shows that they are comparable in this respect (compliance chi^2 test; p > 0.05). Also, the level of differentiation of the score obtained by the examinees in both years and measured by the variance difference points to a similar structure of the result (Levene's test of homogeneity of variance; p > 0.05). However, the average score, median and quartile range show that students from the year 2013/14 achieved statistically higher score than those from the year 2014/15 (non-parametric U Mann-Whitney test; p = 0.02). The value of standardized effect for the observed difference that was evaluated using

a *d*-Cohen coefficient, was 0.326. The percentage of students who did not achieve the assumed pass mark was similar in both groups. Details of the comparative analysis of results for the e-learning course in the subject of *Clinical Research and Basics of EBM* for the two studied years were presented in Table 1. The comparison of reliability of tests evaluated using α-Cronbach coefficient proves that there is a great similarity and relatively high level of internal compliance between the testing measurements in both years of the course (α coefficient 0.77 and 0.76, respectively). Moreover, SEM did not exceed the value of 3 points for none of the studied years (Table 1).

While comparing the score obtained by students in individual modules of the course, it was shown that in case of four out of seven topics, students from the year 2013/14 achieved relatively higher results than those from the year 2014/15. Results of the statistical analysis using a non-parametric U Mann-Whitney test show that for the year 2014/15 the following modules proved more difficult: Types and methodology of clinical research; Evaluation of articles concerning treatment, prognosis or harmfulness; Evaluation of information about the diagnostic method; Guidelines for clinical practice. Details concerning the comparative analysis in the field of score in individual modules for both groups of students are presented in Table 2.

In evaluation of internal validity of both editions it was found that the score achieved by students in four modules testing their practical skills connected with analyzing scientific papers was significantly correlated with the total result of the test. Even though the power of this dependency measured using r-Pearson coefficient was not equal, these differences were not significant (Table 3).

In order to precisely evaluate the internal validity, the analysis of regression was carried out using five independent variables. The analysis excluded the evaluation of influence of the score achieved for the three introductory modules (theoretic ones), including into the model of regression only variables connected with evaluation of practical skills in the field of EBM. The established standardized $\beta \approx 1.3$ for three practical modules present a very similar score in the overall result of the learning outcomes. The lowest influence was presented for the topic range of *Secondary data analysis: meta-analysis and statistical review* ($\beta \approx 1.0$). However, in case of the variable such as the year, no statistically relevant influence was observed for the final score of the e-course. As can be seen in Table 4, the suggested equation of regression in the following form: *(total lack of credit)* $= b_0 + b_1$ *(Evaluation of articles concerning treatment, prognosis or harmfulness)* $+ b_2 \cdot$*(Evaluation of information about the diagnostic method)* $+ b_3$ *(Secondary data*

Table 1. Comparison of total score in Clinical Research and Basics of EBM achieved by students at the Nursing Department in two consecutive years participating in the e-course

Tabela 1. Porównanie wyników zaliczenia z zakresu Badania kliniczne i podstawy EBM uzyskanych przez studentów kierunku Pielęgniarstwo z dwóch kolejnych roczników biorących udział w kursie e-learningowym

	Academic year 2013/14	Academic year 2014/15
N ^	122	140
Mean*	34.2 (33.2–35.1)	32.4 (31.4–33.3)
SD**	5.21	5.52
Median***	36.0	32.0
Q1–Q3	31.0–38.0	28.0–38.0
CV	15.23%	17.05%
α-Cronbach	0.77	0.76
SEM	2.50	2.70
Percentage of students with a maximum score	5.7%	12.1%
Percentage of students below the passing mark	1.6%	1.4%

^ compliance chi^2 test = 1.236; p = 0.266; *value of d-Cohen effect = 0.326; **Levene's homogeneity of variance test = 1.630; p = 0.203; ***non-parametric U Mann-Whitney test = 6954.0; p = 0.02; SD — standard deviation; Q1 — 25% quartile; Q3 — 75% quartile; CV — coefficient of variation; α-Cronbach — reliability coefficient; SEM — standard error of measurement

Table 2. Comparison of score in Clinical Research and Basics of EBM for individual topics (modules) achieved by students at the Nursing Department in two consecutive years participating in the e-course

Tabela 2. Porównanie wyników zaliczenia z zakresu Badania kliniczne i podstawy EBM dla poszczególnych obszarów tematycznych uzyskanych przez studentów kierunku Pielęgniarstwo z dwóch kolejnych roczników biorących udział w kursie e-learningowym

Topic range of a course	Sum of the ranks 2013/14	Sum of the ranks 2014/15	U	p-value*
1. What is EBM (Evidence-based medicine)?	16,759.0	17,694.0	7,824.0	0.242
2. Types and methodology of clinical research	17,325.5	17,127.5	7,257.5	0.036
3. Evaluation of credibility of clinical research	16,647.0	17,806.0	7,936.0	0.324
4. Evaluation of articles concerning treatment, prognosis or harmfulness	17,212.0	16,718.0	7,127.0	0.033
5. Evaluation of information about the diagnostic method	17,137.5	16,532.5	6,941.5	0.019
6. Secondary data analyses: meta-analysis and systematic review	16,079.5	17,590.5	7,999.5	0.562
7. Guidelines for clinical practice	17,136.0	16,017.0	6,564.0	0.005

*non-parametric U Mann-Whitney test

analyses: meta-analysis and systematic review) + b_4 (Guidelines for clinical practice) explains sufficiently the changeability of results obtained by students in an e-course. What proved irrelevant was the influence of the year on the achieved total score in the field of *Clinical Research and Basics of EBM*.

Discussion

According to the U.S. Institute of Medicine "*Health Professions Education: a Bridge to Quality*" report, EBP is one of five basic competences that should be developed and sustained throughout the course of professional work by all employees of health services [5].

Table 3. Analysis of correlation of the obtained results in individual topic areas of *Clinical Research and Basics of EBM* and a total score achieved by students in two consecutive years of an e-learnig course

Tabela 3. Analiza korelacji wyników uzyskanych z poszczególnych obszarów tematycznych *Badań klinicznych i podstaw EBM* a sumaryczną punktacją otrzymaną przez studentów dwóch kolejnych roczników z zaliczenia kursu e-learningowego

Topic range of the course	Academic year 2013/14	Academic year 2014/15
Evaluation of articles concerning treatment, prognosis or harmfulness	0.84*	0.86*
Evaluation of information about the method of diagnosis	0.56*	0.66*
Secondary data analyses: meta-analysis and systematic review	0.69*	0.74*
Guidelines for clinical practice	0.74*	0.66*

*p-value < 0.05

Table 4. Parameters of the model of regression for independent (explanatory) variables: academic year; evaluation of articles concerning treatment, prognosis or harmfulness; evaluation of information about method of diagnosis; secondary analyses: meta-analysis and systematic review; guidelines for clinical practice; and dependent variable: total score for the e-course. Determination coefficient $R^2 = 0.948$, standard error of estimation = 1.254, level of relevance for the model $p < 0.00001$ with $F (5.251) = 913.46$

Tabela 4. Parametry modelu regresji dla zmiennych niezależnych (objaśniających): rok akademicki; ocena artykułów dotyczących leczenia, rokowania lub szkodliwości; ocena informacji o metodzie diagnostycznej; wtórne analizy danych: meta--analiza i przegląd systematyczny; wytyczne praktyki klinicznej; oraz zmiennej zależnej (objaśnianej): łączny wynik punktowy z zaliczenia e-kursu. Współczynnik determinacji $R^2 = 0,948$, błąd standardowy estymacji = 1,254, poziom istotności dla modelu $p < 0,00001$ przy $F(5,251) = 913,46$

Independent variable	b	SE	β	95% CI	p-value
Intercept	–	–	8.220	7.734–8.706	< 0.001
Academic year (0 = 2013/14; 1 = 2014/15)	–0.009	0.015	–0.097	–0.258–0.064	0.547
Score for "Evaluation of articles concerning treatment, prognosis or harmfulness"	0.484	0.018	1.298	1.249–1.347	< 0.001
Score for "Evaluation of information about method of diagnosis"	0.224	0.017	1.374	1.272–1.476	< 0.001
Score for "Secondary analyses: meta-analysis and systematic review"	0.300	0.017	1.082	1.020–1.144	< 0.001
Score for "Guidelines for clinical practice"	0.252	0.018	1.382	1.286–1.478	< 0.001

b — regression coefficients, SE — standard error, β — standardized coefficient (beta coefficient), 95% CI — 95% confidence interval for beta coefficient

However, as can be learnt from the studies carried out in the USA, majority of nurses does not make use of the accessible scientific evidence in their practice (58%). Moreover, 82% of the tested group have never used the library resources at their hospital and 58% have never searched for any publications in such data bases as PubMed/Medline [6]. Also, the results of Polish studies that included evaluation of knowledge among nurses concerning EBP point to insufficient level of preparation both in theory and in practice [7].

The abovementioned observations provoke to undertake urgent actions towards increasing the quality of education in the field of EBM/EBP both among students and nurses who are professionally active.

Students who graduated from the Nursing Department are expected to present the skills necessary in critical analysis of various sources of scientific information as well as the ability to solve problems. These competences are indispensable when making decisions in everyday clinical practice. Due to the

fact that traditional education focuses students' attention on the central role of the teacher-lecturer, this model does not favor developing key EBM/EBP competences [8].

The growing role of e-learning in educating nurses also in the field of developing their EBM/EBP competences is related to the advantages of this method [9]. In particular, the possibility of individual pace of learning is pointed out and adjusting the style of learning to student's preferences. It is also believed that using computers — as opposed to applying only traditional methods of teaching — is conductive to enhancing knowledge, and results in increasing the level of understanding the discussed phenomena and processes. E-courses offer also the possibility to learn certain significant skills, particularly those connected with critical analysis and independent problem--solving [10–13]. Advantages of the Moodle^{TM} listed above became the factor that contributed to planning and implementing e-learning courses concerning *Clinical Research and Basics of EBM* designed to educate students of the second degree at the Nursing Department at MUW.

Similarly, as when applying the traditional methods of teaching, also in the case of e-learning, it is necessary to evaluate students with regard to learning outcomes they achieved. The quality of distant learning is strictly connected with the manner in which an e-course is organized and in particular with monitoring the progress students make and evaluation of knowledge and skills of an e-course participants. Various methods of educational measurement may be used here, however, one of the most frequently used one is an MCQs test. Advantages of tests prepared in this format are appreciated by the teachers who use the Moodle^{TM} platform worldwide, which is reflected in the number of questions of such a type that is currently estimated for over 268 million (http://moodle.net/stats/ [access 6 February 2015]). Comparative analysis of the results of an e-course credit in two consecutive years shows that the measurement of the achieved learning outcomes using an MCQs test maintains a relatively high reliability, low error standard and a similar spread of score achieved by the examinees ($\alpha > 0.7$; SEM < 3; SD ≈ 5.3). These important parameters used in evaluating the quality and equivalence of test question sets reflect the features of objectivism and repetitiveness of learning outcomes achieved by students that are so relevant for every educational measurement.

During the course of *Clinical Research and Basics of EBM*, problem tasks were used while constructing a test. It is a specific type of an MCQs test that requires the student to solve a certain category of a problem. They allow testing not only the knowledge of the rules

and methods of action, but most of all, they test how students understand them. Such a task comprises of two parts: the first one, the more developed one that is a description of a problem drawn from a selected scientific publication which describes a clinical study; the second one which provides a few answers that are to be an appropriate solution to the presented problem [14]. As far as competences connected with EBM/EBP are concerned, such a type of a test is a valuable source of information about an examinee's skills. As mentioned earlier, critical thinking, ability to analyze a text and evaluate information and also solve problems, are the key skills that comprise a student's competences concerning EBM/EBP. On the other hand, MCQs tests are easily analyzed quantitatively, they also enable full automation of the process of checking and generating results. The above advantages of problem tasks with a multiple choice are an important alternative for open-end questions such as an essay or a short-answer question (SAQ).

Since no standardization of an MCQs test was performed on any selected sample so as to establish an empirical standard for the passed/failed threshold, then in relation to the completion of the course of *Clinical Research and Basics of EBM*, the standard of curriculum requirements were applied. In relation to the results of a particular MCQs test, the most important aspect is to establish the quantity norm, i.e. the lowest score achieved that allows to state that a student meets the requirements for a given level [15]. The most important feature of a good educational measurement is objectivism that in its conventional form and in a very narrow approach, means the precision with which the results of this measurement reflect the appropriate curriculum requirements. It is a contractual issue to determine that with a given result we may interpret it in a certain manner. For instance, achieving a "satisfactory" score in a subject is purely a teacher's evaluation of a student's skills, just as in the case of a student achieving a 70% for a task that is properly solved is assumed as mastering the area on a satisfactory level [16]. Quantitative analysis of the obtained results in an e-test allowed establishing a passed/failed threshold on the level of 51%. For groups of students in both groups, the pass rate with such a criterion of assessment (including the retake date) was 98–99%. High pass rate observed for two consecutive years while maintaining a relatively high differentiation in individual results (measured using an ore changeability coefficient and a standard deviation) proves the measurement with the use of an MCQs test correct. Similarity in the structure of score for both years is also a good prognostic indicator in the area of low question database use, which is of importance when maintaining a high level of

reliability and objectivity when evaluating students in consecutive years.

What is relevant in creating good evaluation tools, is determining the validity of a measurement that answers the question "what is being measured?" Validity in this area should be understood as the level of compliance with which a measuring tool measures what it was designed to measure. Thus, it is the usefulness of a given method in evaluating a certain set of features and properties of an examinee [17]. The assumption of the creators of a calculating test was to evaluate the key competences concerning previously mentioned EBM/EBP. In order to verify assumptions referring to the validity of the measurement with the use of problem questions, it was necessary to carry out a *post hoc* evaluation of the test. However, there is no exact method of validity measurement, but only its certain indirect evaluation.

The analysis of validity of students' achievements in the field of *Clinical Research and Basics of EBM* is intended to prevent the abuse in the interpretation of the measurement results [14]. If a student achieved a high score, then the value of such a grade is only relevant if it reflects the student's real achievements, particularly with reference to curriculum requirements. Therefore, one of the important aspects of the analysis of validity of measurement is the evaluation of predictive validity that refers to the measurement of prognostic ability of given results when used in predicting the students' future, e.g., achieving success during the course of studies or the future professional status of a graduate. For obvious reasons, determining the predictive validity in the analyzed case is not possible. We do not have detailed data concerning the students' or graduates' future at our disposal, especially with reference to their potential professional activities after graduation.

Evaluation of test tasks' compliance with the learning outcomes is also relevant in connection with the range of curriculum accuracy of the test that is provided for a given subject. Validation of this parameter was performed on the basis of an e-course scenario elaborated on earlier, which included seven topics, three of which were of a theoretical character and four of which were practical. Evaluation for individual modules was reflected in the content outlines of the test which determined the range of individual questions in the pool of questions, whereas, for internal structure validity, correlates between individual modules of the test were determined. Because the power of correlation, measured with the value of r-Pearson coefficient, was similar for both years of the e-course, it may be assumed that also the validity of the measurement of the achieved learning outcomes was similar for both of the studied groups of students.

Results of the analysis of inter-correlation are to a large extent consistent with the results of compliance in scoring that was evaluated by the value of a reliability coefficient using α-Cronbach coefficient.

Since assuming that r-Pearson linear correlation coefficient a score index in validity research is too simplified a model, much more credible results can be obtained using the analysis of regression. The suggested model of regression included five explanatory variables, four of which covering a score achieved by a student in practical modules and one dichotomous variable — the academic year. Introducing this variable into the equation of regression resulted from the observed difference in score achieved by students in both groups. Significantly higher results were achieved by students from the year 2013/14 as opposed to those in the year 2014/15. This dependence was visible while comparing the mean score (d-Cohen = 0.33) and the median (U Mann-Whitney test, p = 0.02). The difference measured by the value of a standard effect shows that the influence of the year on the achieved score oscillates between the low and medium level ($0.2 < d < 0.5$).

Results of the analysis of regression presented in this paper confirm the above observations obtained from a one-dimension analysis of correlation. The result of the multi-dimensional analysis of regression does not confirm the differences in score that were observed while performing a one-dimensional comparison of two years of students. In order to explain the reasons of this discrepancy, an attempt should be made to extract a group of relevant predictors on the basis of a stepwise regression or suggest another model of the function of regression of non-linear type. These issues, however, are beyond the range of issues discussed here.

Conclusions

The results of the learning outcomes for students of Nursing discussed above, which were carried out using the tools of an e-learning Moodle™ platform show that well-planned distant learning combined with a properly selected educational measurement is an alternative for traditional methods of teaching. A range of empirically confirmed advantages presented in this paper and connected with such a didactic process may have a positive influence on the quality of teaching and ensure gaining the necessary competences in the field of EBM/EBP by the students of Nursing.

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