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RESEARCH ARTICLE

MODEL-BASED CLUSTER AND DISCRIMINANT ANALYSIS IN BRAZILIAN MEDICAL SCHOOL ACADEMIC DISCIPLINES: A NATIONWIDE STUDY USING THE DATA AVAILABLE ON WEBSITES

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ABSTRACT

The aims and objectives of Home Science education have been changed to a greater extent. It is treated as the systematic arrangement for the use of human and non-human resources for deriving maximum satisfaction to bring about qualitative change in life. Further, the study of Home Science opens avenues for a number of vocations. Hence, it was felt necessary to construct a comprehensive, valid and reliable scale and an attempt was made to develop a scale in order to measure the attitude of the students towards Home Science degree programme. Eighteen statements were selected from 26 statements for which the validity was identified with the help content validity method and reliability was determined by split half method which was found to be 0.78.

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INTRODUCTION

The development of the Internet and Web system (www - World Wide Web) allowed organizations to create their media spaces, making visible the most varied information and generating close relationships with diverse publics (Fossá and Sgorla, 2011; Scroferneker, 2005). If well planned, a website has many options for the application of technologies, principally for communication and education (Dziekaniak *et al*., 2006). The benefits of medical school websites are immense and, as a result, many universities have implemented them (Scroferneker, 2005), serving to shape their image and provide predominant curricular information to academics and educational administrators, easily and timely (Roy *et al*., 2014; Thowfeek *et al*., 2014). Currently different studies are performed using the virtual world, as this is important environment for the dissemination of information, including educative studies (Freitas *et al*., 2015), some focusing on learning and usability (on social media platforms such as blogs, wikis, micro-blogs and social networking website, websites and personal page) (Alur *et al*., 2002; Thowfeek *et al*., 2014; Bullock and Webb, 2015; Lin *et al*., 2015; Panahi *et al*., 2015) others on the implementation of the curriculum with focus on secure messaging between patients and physicians (Crotty *et al*., 2013) and some that analyze the curriculum of universities (questionnaire by email and/or websites) (Jippes *et al*., 2011; Brekke *et al*., 2013).It was chosen to collect data from the websites of Brazilian medical schools, considering that currently the Internet is more interactive and oriented toward the user (Souza *et al*., 2014), searching for the disciplines that contain content related to teaching CS. Since 2001, Brazilian Guidelines for undergraduate medical education have highlighted the need to include communication skills (CS) in the curriculum (DCNM 2001). The teaching of CS should be performed throughout the entire medical program, with increasing complexity, based on evidence, applying theory to practice and usually integrated with other topics throughout the program (Von Fragstein *et al*., 2008; Weel-Baumgarten *et al*., 2013).

Despite the recommendations of the Brazilian Guidelines, up to now, it is not known how the Brazilian medical schools are

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adapting their curricula to provide the teaching of communication skills. Considering that the formal education of physicians seems to converge, respecting national specificities, this research model proposes examining the evidence relating to common and differentiating factors existing in the curricula (various disciplines that have contents directed toward teaching communication skills) of the medical schools in Brazil. Teaching communication skills provides healthcare students, through various disciplines, with an opportunity to collaborate as a component of their prior training (Lin *et al*. 2015). As an initial way to verify this, the present study was carried out to analyze proximity of academic disciplines that have contents directed toward teaching communication skills (CS), using secondary data available on the websites of all Brazilian medical schools, classifying them by clusters and discriminant analysis.

METHODS

This was a study using secondary data available on the websites of all Brazilian medical schools registered with the Brazilian Education Ministry (e-MEC) system in July 2014. The study was conducted using three searches for the data collection: a) e-MEC, which is an electronic system available at <http://emec.mec.gov.br> that regulates higher education in Brazil including the accreditation, re-accreditation, authorization, and certification processes of higher education programs, b) the Brazilian Federal Council of Medicine (CFM) at <http://portal.cfm.org.br>, which is the authority with constitutional powers of supervising and regulating medical practice in Brazil and c) the websites of each medical school for the analysis of their curricula.

These websites are constantly updated with information on the school administration, sponsoring entity, as well as enrollment details of all medical schools in Brazil. The inclusion criteria were schools that published their teaching programs with corresponding courses or modules on their websites, with communication skills content in the course syllabus, disciplines and words (doctor-patient relationship, followed by verbal communication, nonverbal communication, communication aspects, bad news, interpersonal skills, humanities, education and health communication, ethical aspects, and empathy). The following variables were analyzed: geographic location in Brazil (Northern, Northeast, Central-west, Southeast, and Southern regions); teaching methodology; hour workload of communication courses and number of semesters of communication courses.

In Brazil, the medical program has duration of six years with the medical internship carried out during the final two years of the program. It was not possible to analyze communication skills teaching during the medical internship period (9^{th} –12^{th} semesters) as the schools only publish course details up to the 8^{th} semester. The study did not require approval of the ethics committee because it did not collect data on humans. The data are public and published on the websites of the universities. The confidentiality and anonymity of the institutions were maintained, which are identified only by Brazilian region. Descriptive data analysis was performed using the SPSS (IBM SPSS Statistics 22) software. Frequencies for the variables and categories of interest were calculated. Chi-square analysis was used for the categorical measures. The accepted level of significance was $p < .05$. Cluster analysis was performed with: hierarchical clustering (all Brazilian medical schools < 250); dendrogram (cluster tree); k-medoids similarity algorithm and delimited clusters by quadratic Euclidean distance (Mun *et al*. 2008). Discriminant Analysis (DA) was then performed to validate the cluster analysis, identifying the variables that best discriminated the clusters (Pestana *et al*. 2000). Box's M test did not reject the hypothesis (H0) of equal variance-covariance matrices (homoscedasticity). Next, stepwise DA with Wilks' Lambda (Λ) was performed and the value of F Multivariate Statistics for the difference between the centroid of the test groups.

RESULTS

From the 237 schools registered, 83 met the inclusion criteria and provided data up to the 8^{th} semester. Figure 1 shows a flow algorithm that describes the selection procedure of the schools participating in the study. In the remaining schools, 63 showed only the course name on their website; none explicitly included the words "communication skills", "communication", or "doctor-patient relationship", which, prevented analysis. There were, 91 that did not include information on the courses or their respective syllabuses. The number of schools that included all data on their websites differed by geographic region. It was higher in the North [12 out of 19 schools (63.2%)] followed by the South [16 out of 40 schools (40.0%)], the Southeast [35 out of 100 schools (35.0%)], the Northeast [15 out of 58 schools (25.8%)] and the Central-west [05 out of 20 schools (25.0%)], x2 (4, N = 83) = 10.06, $p = .03$.

The most common words related to communication skills in the syllabus were doctor-patient relationship [67 (45.98%)], followed by verbal/nonverbal communication, communication skills, education and health communication [49 (33.49%)], ethics, bioethics, communicative ethics in decision-making in medical practice, ethics and humanism [09 (6.16%)], empathy and sympathy [07 (4.79%)], bad news [04 (2.74%)], humanities in medicine, humanities in health, Human relations [03 (2.05%)], interpersonal and group skills [02 (1.37%)], writing skills and reading/language, speaking, re-textualization and contextual adaptation with an emphasis on interpersonal relations and human care [02 (1.37%)], listening and behavior/speech and listening [02 (1.37%)] and incorporation of information technology, communications and robotics into education and medical practices/ Scientific communication [01 (0.68%)]. Of the 83 schools analyzed, some had more than one course or module that included communication skills in their syllabus—this totaled 101 disciplines. The number of schools that included all data on their websites differed by characteristics, being separated (homogeneous subgroups by disciplines) by three clusters. *Cluster 1*: Methodology - (traditional curriculum 54 out of 89 schools (60.7%), problem-based learning (PBL) 18 out of 89 schools (20.2%), modular 10 out of 89 schools (11.2%) and schools using other methodologies 07 out of 89 (07.9%). Number of semesters of communication courses - (1 semester 72 out of 89 schools (80.9%), 2 semesters 11 out of 89 schools (12.4%), and schools using 3, 4, 5, 6 semesters 06 out of 89 (06.7%)).

Table 1. Standardized discriminant function coefficients

Funtion	% of Variance	% cumulative	Canonical correlaction	F	df	sig
Factor 1	98.2	98.2	0.917	233.63	2	0.000*
Factor 2	1.8	100	0,296	78.47	4	0.000*

Factor 1 - Hour load of communication courses; Factor 2 - Number semesters of communication courses; level of significance p < .05*

Table 2. Wilk's Lambda

Funtion	Wilk's Lambda	Chi-square	df	sig
1 throught 2	0.146	187.67	4	0.000*
2	0.912	8.92	1	0.003*

Factor 1 - Hour load of communication courses; Factor 2 - Number semesters of communication courses; level of significance p < .05*

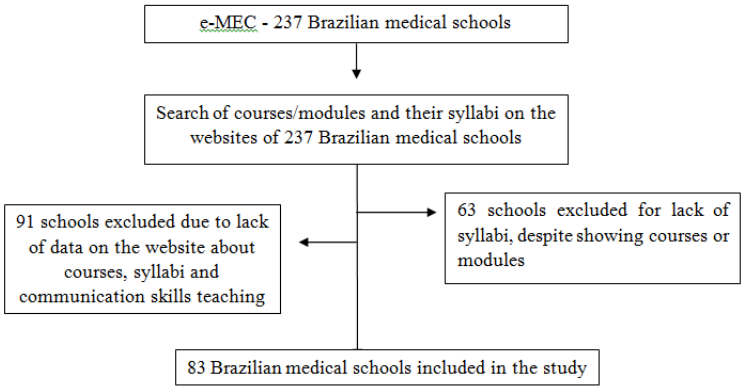

Figure 1. Flow Diagram, Results for selecting medical schools

Hour workload of communication courses - (from 18h to 180h, P50=60h, P25/P75=40/102). *Cluster 2*: Methodology - (traditional curriculum 03 out of 09 schools (33.3%), PBL 03 out of 09 schools (33.3%) and schools using other methodologies 03 out of 09 (33.3%). Number of semesters of communication courses - (8 semesters 04 out of 09 schools (44.4%), 1 semester 03 out of 09 schools (33.3%), and schools using 2, 6 semesters 02 out of 09 (22.3%)). Hour workload of communication courses - (from 204h to 324h, P50=240h, P25/P75=240/280). *Cluster 3* Methodology - (all schools using PBL 03 (100%)). Number of semesters of communication courses - (2 semesters 02 out of 03 schools (66.7%), 8 semesters 01 out of 03 schools (33.3%)). Hour workload of communication courses - (from 480h to 560h, P50=480h, P25/P75=480/520).

The standardized canonical discriminant function coefficients showed that the variables hour workload of communication courses and number semesters of communication courses presented higher predictor magnitudes and greater contributions. The F Multivariate Statistics showed that two variables were significantly different between the centroid of clusters (p = .000) (Table 1). The discriminant analysis by stepwise and Wilks' Lambda method produced a canonical correlation of .917, which can be interpreted as meaning that 91.7% of the variance between the three groups (Table 1) was explained by the hour workload of communication courses. In the analysis of the functions as a set, it was confirmed that both the discriminant functions were highly significant, showing differences between the clusters.

DISCUSSION

Discipline analysis offers a complementary way to explore communication skills teaching and, in the present study, it was observed that Brazilian medical schools differ in communication skills teaching. The cluster analysis showed three clusters of academic disciplines. The results seem to show a very wide variability between medical schools curricula. Cluster 1 shows predominance of traditional Methodology followed by PBL, in cluster 2 methodologies were homogeneous between traditional and PBL, and in cluster 3 all the schools used PBL. The hour workload of communication courses is important for the understanding of how to tailor the curricula, providing adequate academic knowledge for good medical education (Calais *et al*., 2001; Anderson, 2015). The results of the discriminant analysis validated the cluster analysis, confirming that the main discriminatory variable was the hour workload of the communication courses, followed by the number of semesters of the communication courses.

It was found that academic disciplines that have contents aimed at teaching communication skills are usually given in the early stages of the program, most of the time they are only offered for one period in the curriculum and the hour workload of the communication courses is from 18h to 180h (Cluster 1). In cluster 2 this teaching is from 204h to 324h. In cluster 3, these disciplines were better distributed throughout the course, being from 480h to 560h. Similar differences have been seen at some institutions of other countries. In 2013, Rosenbaum and

Axelson (2013) found that the teaching of communication skills to US physicians usually occurs in the early years of the undergraduate program, with only a few schools continuing this training during the final years. Gude *et al.* (2005) showed that in four Norwegian universities (1 traditional and 3 PBL) there were differences, both with regard to the total time allocated to the teaching and the distribution over the six years of the course. This shows that, although some content is being provided, the curriculum still has to be improved by offering communication skills throughout the training process, with increasing complexity. This has occurred in the institutions of other countries, which have introduced communication skills integrated with medical content and longitudinal, such as the Radboud Nijmegen Medical Center (Netherlands) (Weel-Baumgarten *et al*., 2013) the University of Hamburg (Bachmann *et al*., 2013) and the Faculty of Medicine of the University of Porto (FMUP) (Loureiro *et al*., 2012).

Though communication has been recognized as a core competency for the professional, variability in how this skill set is taught leads to heterogeneous learning (Gillis *et al*., 2015). To increase the hour workload of this teaching and its complexity throughout the medical training has been shown to be increasingly important, as communication breakdowns are among the most frequent contributors to adverse events in medicine (Greenberg *et al*., 2007). One limitation of this study is the difficulty to accurately estimate the hour workload intended for TCS within each discipline. It was also not possible to analyze the total hour workload of courses/modules that include communication skills in their syllabuses because it was not possible to analyze the teaching plans. Thus, the hour workload assigned to teaching communication skills might be lower than the total hour workload of these courses/modules. However, it is clear that in courses/modules called "Communication Skills" the total hour workload is assigned to teaching communication skills.

The data obtained through these websites at a particular point in time may not reflect the current situation, as the curricula of education institutions are constantly evolving (Rosenbaum and Axelson 2013). The last decade has seen an explosion of social media-based medical education resources including blogs, websites and podcasts that are increasingly being used for medical education (Loureiro *et al*., 2012). In addition, it was expected that the medical schools' websites would make more information available online about their curriculum from the first to the final year of program. However, the study clearly indicates that, although some content on communication skills is being provided, the curriculum still has to be improved by offering communication skills throughout the training process, with increasing complexity. More studies are needed, including studies with the managers of each medical school to facilitate more precise analysis of the teaching of communication skills.

Conclusion

The study findings suggest that all the medical schools studied offer courses/modules that include academic disciplines and words related to communication skill in their syllabuses. The most cited words in the syllabuses were doctor-patient relationship followed by communication (verbal, nonverbal, communication aspects), empathy, and ethical aspects. Furthermore, the cluster analysis of the academic disciplines that had contents directed toward teaching communication skills, revealed three groupings, which exhibit differences in characteristics, such as teaching methodology, hour workload of the communication courses and number of semesters of communication courses. It was found that the hour workload of the communication courses was the most powerful predictor of classification proximity of the academic disciplines.

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