# University faculty on student motivation to use medical education apps and barriers to their usage

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**Abstract.** – **OBJECTIVE:** University teachers, who primarily provide guidance and advice to their students, can play a significant role in educational process transformation. As there is no particular e-learning framework, it is important to understand the factors and variables that may impact both its effective usage and further successful implementation. The current study aims to outline the influence of university faculty, and possible barriers preventing medical students from using apps for learning purposes.

**SUBJECTS AND METHODS:** A cross-sectional study was conducted with an online survey questionnaire. The population of the study included 1,458 students from all the seven Greek schools of medicine.

**RESULTS:** University faculty (51.7%), followed by fellow students and friends (55.6%), constitute the second most common source of information on adopting apps for medical education. 45.8% of students rated their educational guidance as insufficient/inadequate, 33.0% as moderate, 18.6% as quite good, and only 2.7% as sufficient/complete.

University professors have proposed certain apps to 25.5% of students. PubMed (41.7%), Medscape (20.9%), and Complete Anatomy (12.2%) were the leading suggestions. The main barriers to app usage were the lack of knowledge of apps' benefits (28.8%), insufficient updates of their content (21.9%), their cost-effectiveness (19.2%), and financial reasons (16.2%). Most students preferred using free apps (51.4%) and 76.7% preferred universities to cover apps' expenses.

**CONCLUSIONS:** University faculty represent the main source of information regarding the adaptation of medical apps in the educational process. However, students need improved and enhanced guidance. The main barriers are ignorance about apps and financial reasons. The majority prefer free apps and universities to cover their cost.

*Key Words:*
    University faculty, Professors, E-learning, Medical apps, Assimilation, Pregraduate students.

## Introduction

Undergraduate medical education has been traditionally lecture-based. Recent enormous technological advances have led to the gradual adaptation of electronic learning (e-learning). Honey and Mumford[1] classify trainees into four distinct categories: theorists, pragmatists, activists, and reflectors. Sfard et al[2] argued about two learning models: the participation model and the acquisition model. The first emphasizes the participation in a social community, while the second focuses on the individual and its learning needs. Nonaka[3] supported that the creation of knowledge is a two-stage process. A core knowledge base, the so-called "explicit" knowledge, becomes "tacit" knowledge through experience and practice. Further, contextualization of knowledge, a concept proposed by Lave and Wenger[4], and a learning model formulated by an educational need acting as a trigger to supplement knowledge gaps, described by Davies et al[5], constitute along with the pivotal applications ("apps") the main sources of gaining knowledge. Apps are self-contained software that can serve multiple and distinct functions, including interactive learning, e-books, immediate access to medical information, illustrations, and videos. Mobile devices can run relevant apps and provide timely access to key facts, enabling learning in context and by repetition by supplementing diverse ways of learning, in a timewise manner[5-7]. Several medical schools have recognized the high potential of apps in the e-learning process and not only encourage their use but also have integrated them into their curricula[8-10].

Although numerous studies[5,8,10-16] have shown high ownership rates of computer devices among medical students, the adaptation of apps in medical education and future professional practice varies significantly. As user acceptance is a determinant factor for the integration of innovative learning methods, inhibitory factors should be investigated and evaluated accordingly.

The roles and responsibilities of college and university faculty are closely correlated to the central functional regulations of higher education. According to the "Declaration of Principles" formed by the American Association of University Professors (AAUP)[17,18], the role of colleges and universities is "to promote inquiry and advance the sum of human knowledge, to provide general instruction to the students, and to develop experts for various branches of the public service". Correspondingly, college and university faculty members undertake research, teaching, and service roles to accomplish the academic work of their respective institutions. Each role enables faculty members to generate and disseminate knowledge to peers, students, and external audiences. The teaching role of faculty members reflects their significance in fulfilling the primary educational mission among colleges and universities. Faculty members should teach, guide, and support their students with the learning process, and promote the knowledge application in clinical practice. In the context of the teaching role, the teacher should serve as the content expert, and students should be regarded as learners or novices of the academic field of study. Faculty staff is expected to follow the developments in the field, so their expertise and knowledge base remains updated. Part of the institutional service performed by faculty is "advising" students as well[10,17-20].

Taking the abovementioned into consideration, the present study aims to outline the impact of university teaching staff on the application integration into medical education, and possible barriers in their implementation as a learning resource.

## Subjects and Methods

A cross-sectional descriptive study was conducted. The population of the study included 1,458 students from all the seven Greek Schools of Medicine (National and Kapodistrian University of Athens, Aristotle University of Thessaloniki, University of Crete, University of Thessaly, University of Ioannina, University of Patras, Democritus University of Thrace). Convenience sampling was used: data were collected by an online survey questionnaire supported by Google Forms, which was administered through social media. Partition in the survey was anonymous and voluntary. Participants were acquainted with the study's purpose prior to their consent. The survey was approved by the Ethics Committee of the University of Patras. There were no exclusion criteria.

The questionnaire was contracted upon previous literature[5,14,15,21-25] and researchers' personal experience. It was revised by an expert panel for content validity and reliability. The questionnaire was piloted with 40 randomly selected medical students and suitably reformed. It consisted of three parts, overall, 11 questions, 10 multiple

choice and 1 open ended. Part one comprised of questions designed to gather demographic parameters of the study's sample, namely gender, affiliated university, and year of study. Part two of the questionnaire contained four questions evaluating the influence of academics in the integration of apps in medical education. Part three comprised of four subjects, as well, investigating barriers in using apps. The questionnaire is available in **Appendix**.

### *Statistical Analysis*

The collected data were entered and analyzed using SPSS software ver. 27 (IBM, Armonk, NY, USA). For the data analysis, both descriptive and inferential statistics were used wherein the general frequency, and percentage were obtained as part of descriptive analysis, and inferential analysis was performed using the non-parametric Chi-square test to evaluate difference between categorical variables. The interpretation of the association was based on the obtained *p*-value. A *p*-value of 0.05 was assumed to denote significance.

## Results

A total of 1,458 students, 532 (36.5%) men, 912 (62.5%) women and 14 (1.0%) who did not state their sex, voluntarily participated in the online survey among all medical schools in Greece [National and Kapodistrian University of Athens, n=271 (18.6%), Aristotle University of Thessaloniki, n=313 (21.5%), University of Crete, n=182 (12.5%), University of Thessaly, n=117 (8.0%),

University of Ioannina, n=170 (11.7%), University of Patras, n=273 (18.7%), Democritus University of Thrace, n=117 (8.0%), Prefer not to state, n=15 (1.0%)]. The distribution of respondents within each year of medical studies was 288 (19.8%) in 1st year, 234 (16.1%) in 2nd year, 188 (12.9%) in 3rd year, 199 (13.7%) in 4th year, 231 (15.8%) in 5th year, and 318 (21.8%) in 6th year.

University teachers were a significant source of information concerning medical apps (51.7%), compared to the other sources of information: fellow students/friends (55.6%), personal search (49.2%), apps store platforms (33.4%), and advertisements (21.6%). Only 2.7% evaluated the quality of the information provided as complete, 45.8% as insufficient/inadequate, 33.0% as moderate, and 18.6% as quite good (Table I).

25.5% stated that they had been recommended at least one medical app. In most cases (65.6%) there was no app recommendation. 8.9% preferred not to answer. Corresponding percentages among universities fluctuated around the median percentage of 24.3% (Table I). The most frequent app recommendations were PubMed (41.7%), followed by Medscape (20.9%), Complete Anatomy (12.2%), and UpToDate (11.4%) (Figure 1).

Barriers in app usage (recognized as inhibiting factors and technical problems) are shown in Table II. Lack of knowledge of their benefits (28.8%), insufficient content update (21.9%), cost-effectiveness reasons compared to alternative choices (19.2%), students' financial weakness (16.2%), and difficulty in usage (14.4%) were the predominant barriers. Technical problems (Table II) constituted a comparatively less discouraging group of factors. 14.4% reported difficulty in

**Table I.** Students' evaluation of university teachers' counselling regarding medical apps and relevant app recommendation percentages per affiliated university.

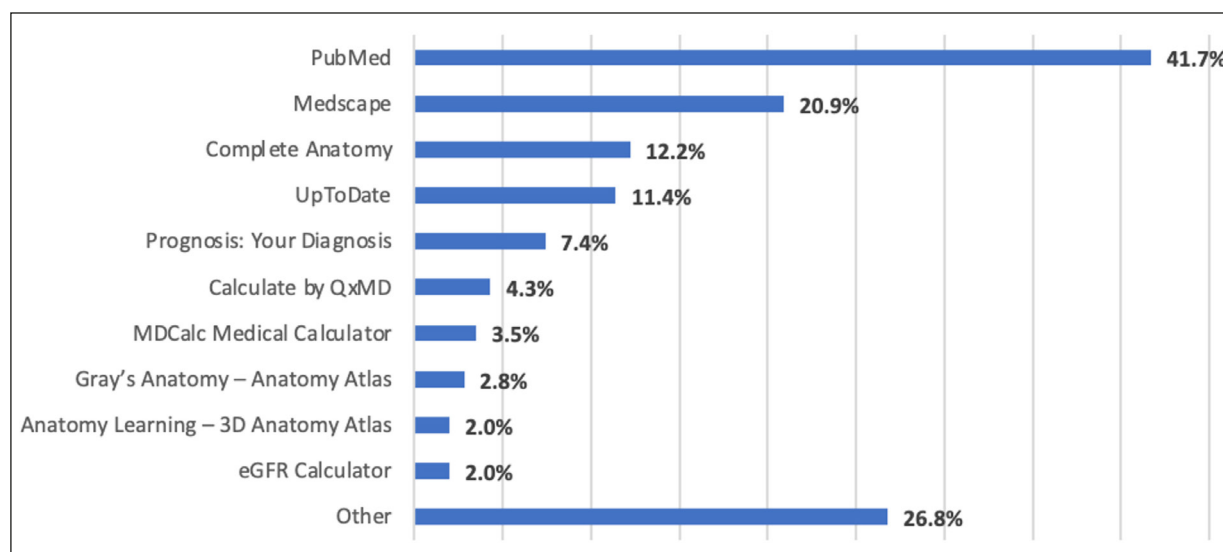| Affiliated University | Evaluation* | | | | App recommendation |
|---|---|---|---|---|---|
| | Insufficient/ Inadequate | Mediocre | Enough Satisfactory | Complete | |
| *University of:* | | | | | |
| Athens | 47.0% | 32.5% | 16.6% | 4.0% | 28.0% |
| Thessaloniki | 48.6% | 35.3% | 14.5% | 1.7% | 24.3% |
| Crete | 57.1% | 35.7% | 7.1% | 0.0% | 20.9% |
| Thessaly | 25.9% | 34.1% | 32.9% | 7.1% | 42.7% |
| Ioannina | 44.0% | 28.0% | 25.3% | 2.7% | 27.6% |
| Patras | 45.5% | 31.3% | 20.9% | 2.2% | 20.5% |
| Thrace | 50.0% | 32.7% | 17.3% | 0.0% | 22.2% |

*Chi$^2$=42.519, *p*<0.001.

**Figure 1.** Main Apps recommended by university teachers.

usage, 8.3% were unable to choose the right app for their needs, and 3.3% confronted hardware restrictions. No significant difference was found among universities concerning inhibiting factors ($p$=0.372) and technical problems ($p$=0.509).

Expenditure was further investigated. Most students (51.4%) preferred using free apps, 12.1% paid annually 1-5 €, 14.6% 5-20 €, 7.1% 20-50 €, and 4.5% contributed to more than 50 € every year. Expenses on app purchases differed significantly among universities ($p$=0.022, Table III).

76.7% of students claimed that universities should contribute to apps' expenses, 11.7% expressed the opposite opinion. No differences were found among universities ($p$=0.943).

## Discussion

Current study confirmed that medical university faculty acknowledged the potential of apps in medical education and contributed to the as-

**Table II.** Barriers to medical apps usage.

|  | Percentage |
|---|---|
| *Inhibitory Factors** |  |
| Lack of knowledge of their benefits | 28.8 |
| Insufficient update of their content | 21.9 |
| Alternative educational choices are more cost-effective | 19.3 |
| Financial weakness to purchase apps | 16.2 |
| I prefer to limit the usage of technological devices for health reasons | 5.8 |
| Unreliable content | 2.8 |
| Other | 13.9 |
| I don't know/answer | 24.7 |
| *Technical Problems*** |  |
| I do not confront any technical problems | 55.3 |
| User unfriendly or difficulty in usage | 14.4 |
| Incapacity to choose the right app due to inadequate apps description | 8.3 |
| Device's inability to run the App | 3.3 |
| Other | 2.1 |
| I don't know/answer | 15.8 |

*Chi$^2$=38.153, $p$=0.372. **Chi$^2$=23.189, $p$=0.509.

**Table III.** Annual expenses on app purchases among universities.

| Affiliated University | Annual Expenses | | | | |
|---|---|---|---|---|---|
| | 0 € (free apps) | 1 - 5 € | >5 - 20 € | >20 - 50 € | >50 € |
| *University of:* | | | | | |
| Athens | 63.1% | 9.2% | 16.9% | 6.2% | 4.6% |
| Thessaloniki | 51.2% | 16.3% | 19.1% | 7.7% | 5.7% |
| Crete | 54.3% | 14.0% | 15.5% | 12.4% | 3.9% |
| Thessaly | 47.4% | 15.8% | 13.2% | 18.4% | 5.3% |
| Ioannina | 67.0% | 11.0% | 13.8% | 3.7% | 4.6% |
| Patras | 54.1% | 14.1% | 17.1% | 7.6% | 7.1% |
| Thrace | 69.2% | 11.5% | 15.4% | 2.6% | 1.3% |

similation of technological advances in the education process in Greece. A considerable percentage of students (51.7%, 2nd higher) identified their tutors as a source of information regarding medical apps. Corresponding percentages are in accordance with relevant studies[14,21]. Only friends and fellows revealed a higher percentage (55.6%) but relatively proximal to the expected one. Personal search upon apps involved almost half of students suggesting a particular interest in the field.

Our findings provide strong evidence that the university faculty role was restricted in providing an overall educational guidance. Only 2.7% evaluated professors' counselling as complete, whilst 45.8% as insufficient/inadequate. In most cases (65.6%) there was no app recommendation, despite this may partially implicate the lack of clearly expressed preference that might be perceived as discriminatory product promotion. The higher recommendation rates in the medical school of the university of Thessaly may correlate to the comparatively smaller number of students in each year of medicine, fact that might have promoted proximity facilitating interpersonal communication between scholars and their students. The mean number of students in each year of medicine per medical school was as follows: National and Kapodistrian University of Athens: 340, Aristotle University of Thessaloniki: 340, University of Crete: 170, University of Thessaly: 110, University of Ioannina: 150, University of Patras: 230, Democritus University of Thrace: 140. PubMed was predominantly recommended. University faculty recommendations mainly were focused on disease diagnosis/management apps, despite the undeniable benefits of other app categories, such as drug reference guides, medical calculators, general healthcare, interactive learning, and e-books[24-27]. Currently, several questions remain unanswered. Further research should be conducted to investigate university faculty attitudes, concerns, and impact on promoting e-learning.

Cost and ignorance of apps benefits represented the main barriers to using them for educational purposes (Table II). The unawareness of apps' benefits possibly relates not only to the limited usage, but also to medical students' hesitance to invest in medical apps. 51.4% of the participants reported that they would prefer free apps. Previous research has identified cost as a main restricting factor as well[11,14]. A possible solution, supported by the majority of participants in this survey (76.7%), is for universities to contribute to apps' costs. At an individual level, it would improve app accessibility promoting universal use. The reported average price of paid medical apps' is 6.7 €, while the popular medical apps' average cost is much higher: 21.1 €[27-29]. Taking into account that only 11.6% allocated more than 20 € per year for medical app purchases, the university's contribution in alleviating the cost may promote wider utilization of apps in terms of both quantity and quality.

Current study was set out to demonstrate the impact of university faculty on promoting the use of medical apps in education and to evaluate relevant restricting factors. Results elucidate the need of proper guidance provided by institutions as well as learning process enhancement by faculty, avoiding unintentional legal breaks mainly on commercial matters. Multicenter approach and the high participation are clear strengths. The present survey was conducted during the university term to ensure a representative student response.

## Limitations

However, this study faces certain limitations. It was a cross-sectional and questionnaire-based voluntary and anonymous online survey so that participants may have responded in a casual manner.

## Conclusions

University faculty represent a leading source of awareness about medical apps, although their role in apps' assimilation seems superficial. The majority of students evaluate poorly the quality of delivered information. The main barriers in app usage are lack of awareness and financial reasons. Cost influences students' choices, as the majority use free apps and express the need for institutional contribution to apps' expenses.

### Ethics Approval

The study protocol was approved by the Research Ethics and Deontology Committee of the University of Patras where the survey was performed (approval No. 7016/18.12.2020). The planning conduct and reporting of human research are in accordance with the Declaration of Helsinki.

### Informed Consent

All participants have signed an informed consent prior to the completion of the online questionnaire.

### Availability of Data and Material

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### Conflict of Interest

The authors declare that there is no conflict of interest.

### Authors' Contributions

Conceptualization: Konstantinos Kagkelaris. Methodology, validation, data analysis and interpretation, visualization: Konstantinos Kagkelaris, Panagiotis Plotas, George Panayiotakopoulos, Constantinos D. Georgakopoulos, Eleni Jelastopulu. Data acquisition: Konstantinos Kagkelaris, Natalia Amasiadi, Andreas Gerakaris, Vasiliki Giorgalla, Panagiotis Efthymiou, Ioanna Efstathiou, Ilias Ziakas, Amalia Katsifara, Christoforos Kitsos, Sokratis Kolios, Ariadni Konstantopoulou, Eleni Kyprioti, Stylianos Mastronikolis, Maria-Myrto Papadopoulou, Nikolaos Razos, Ioannis Schinas, Katerina Skourou. Writing-original draft: Konstantinos Kagkelaris. Writing – review and editing: Panagiotis Plotas, Nikolaos G. Kounis, Ioanna Koniari, Eleni Jelastopulu, Constantinos D. Georgakopoulos. Supervision, project administration: Nikolaos G. Kounis, Eleni Jelastopulu, Constantinos D. Georgakopoulos. All authors read and approved the final manuscript.

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