Lecture Notes in Networks and Systems 390

Michael E. Auer
Hanno Hortsch
Oliver Michler
Thomas Köhler *Editors*

Mobility for Smart Cities and Regional Development - Challenges for Higher Education

Proceedings of the 24th International Conference on Interactive Collaborative Learning (ICL2021), Volume 2

Springer

Lecture Notes in Networks and Systems

Volume 390

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Editors

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Preface

ICL2021 was the 24th edition of the International Conference on Interactive Collaborative Learning and the 50th edition of the IGIP International Conference on Engineering Pedagogy.

This interdisciplinary conference aims to focus on the exchange of relevant trends and research results as well as the presentation of practical experiences in Interactive Collaborative Learning and Engineering Pedagogy.

ICL2021 has been organized by Technische Universität Dresden and University of Applied Science Dresden, Germany, from September 22 to 24, 2021, as a hybrid event.

This year's theme of the conference was "Mobility for Smart Cities and Regional Development – Challenges for Higher Education".

Again, outstanding scientists from around the world accepted the invitation for keynote speeches:

- **Gyeung Ho Choi**, Professor at Daegu Gyeongbuk Institute of Science and Technology, Korea.
  Speech title: Challenges for Future Mobility
- **Thoralf Knote**, Head of Department, Fraunhofer Institute IVI, Germany.
  Speech title: *Involvement of Students in the Project Work at Fraunhofer IVI*
- **Krishna Vedula**, Founder and Executive Director of IUCEE, India.
  Speech title: *Addressing the Challenges of Engineering Pedagogy in India*
- **Stefan Odenbach**, Dean of Studies for Mechanical Engineering at TU Dresden, Germany
  Speech title: *Practical Courses without Presence – is this possible?*
- **David Guralnick,** Kaleidoscope Learning, USA
  Speech title: *Successful Learning Experiences Design*
- **Lars Seiffert,** Board Member, Verkehrsbetriebe AG Dresden, Germany
  Speech title: *Priority for Public Transport – Fair and Green*
- **Ulrike Stopka,** Professor for Communications Economics and Management at TU Dresden, Germany

Speech title: *Challenges and Opportunities for a Transport Sciences-Oriented Study Program*

The following very interesting workshops have been held:

- ***Modern Vehicle Engineering Training up to Connected and Automated Driving***
  Facilitators: **Oliver Michler, Professor for Traffic Telematics at TU Dresden, Germany, and Toralf Trautmann, Professor for Mechatronics at University of Applied Sciences Dresden, Germany**
- ***From Face-to-Face to Hybrid Events – Experiences with the Digital Transformation of a Conference Series Dealing with Online Network Research***
  Facilitator: **Thomas Köhler**, **Professor for Media Technology at TU Dresden and Director of the Center for Open Digital Innovation and Participation at TU Dresden**

We would like to thank the organizers of the following Special Sessions:

- Games in Engineering Education (GinEE)
  Chair: **Matthias C. Utesch**, FOS/BOS Technik München, Germany
- Entrepreneurship in Engineering Education 2020" (EiEE'20)
  Chair: **Jürgen Jantschgi**, HTL Wolfsberg, Austria
- Engineering Education for "Smart Work" and "Smart Life" (IPW)
  Chair: **Steffen Kersten**, TU Dresden, Germany
- Assessing and Enhancing Student online Participation and Engagement
  Chair: **M. Samir Abou El-Seoud**, The British University in Egypt
- Smart Education of Digital Era
  Chair: **Irirna Victorovna Makarova**, Kazan Federal University, Russia

Since its beginning, this conference is devoted to new approaches in learning with a focus to collaborative learning and engineering education. We are currently witnessing a significant transformation in the development of education. There are at least three essential and challenging elements of this transformation process that have to be tackled in education:

- the impact of globalization and digitalization on all areas of human life,
- the exponential acceleration of the developments in technology as well as of the global markets and the necessity of flexibility and agility in education,
- the new generation of students, who are always online and don't know live without Internet.

Therefore, the following main themes have been discussed in detail:

- Collaborative Learning
- Mobility and Smart Cities
- New Learning Models and Applications
- Project-Based Learning

- Game-Based Education
- Educational Virtual Environments
- Computer-Aided Language Learning (CALL)
- Teaching Best Practices
- Engineering Pedagogy Education
- Public-Private Partnership and Entrepreneurship Education
- Research in Engineering Pedagogy
- Evaluation and Outcomes Assessment
- Internet of Things and Online Laboratories
- IT and Knowledge Management in Education
- Approaches of Online Teaching
- Virtual and Augmented Learning
- Mobile Learning Applications
- Connection between Universities and the Labor Market
- Further Education for Engineering Educators

As submission types have been accepted:

- Full Paper, Short Paper
- Work in Progress, Poster
- Special Sessions
- Workshops, Tutorials.

All contributions were subject to a double-blind review. The review process was very competitive. We had to review more than 500 submissions. A team of about 240 reviewers did this terrific job. Our special thanks go to all of them.

Due to the time and conference schedule restrictions, we could finally accept only the best 156 submissions for presentation.

The conference had more than 250 online and on-site participants from 42 countries from all continents.

Our special thank goes to **Prof. Dr. Thomas Köhler and his team** of Technische Universität Dresden, Germany, who made the hybrid conference a reality. We thank **Sebastian Schreiter** for the technical editing of this proceedings.

ICL2022 will be held in Vienna, Austria.

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Contents

Teaching Best Practices

Efficacy of Training Conditions and Methods for medical Students – A large Sample qualitative longitudinal Study

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Abstract. To investigate medical students' learning preferences is the key to successfully adapt to the changing demands and technological opportunities.

Between 2014 and 2019 we sent out 14916 anonymous questionnaires once a year to all medical students at the Medical-University of Graz Austria.

A share of 18% (N = 2799) of invited participants completed the survey. The challenge for students is time management. Students can learn efficiently, if bureaucracy do not get out of hand. The examination system has significant effects on the way and quality of learning and on time management. Especially for in-depth learning, it is difficult and time consuming to select from the available resources and to sort out the relevant examination material. The preferred learning resources for exams are still lecture material and books. The learning preferences do not change much during the course of studies, furthermore the gender differences are in general slightly more noticeable at the beginning but they even out fast during the course of medical school.

To reach the goal of producing well trained graduates, the education institution has to guide the students from a more school-like setting at the begin of their education in the preclinical years to self-employed physicians at the end of their studies.

Keywords: Medical teaching · Virtual learning · Best practice

1 Introduction

Not only the starting situation of medical students, but also the medical profession, the professional environment, the technological progress in medicine and the nature and needs of patients are more diverse than any time in the past. For these named reasons it is hardly surprising that the requirements and also the challenges [1, 2] posed to the students provide a wide and valuable field of research. Even the daily newspapers have recently discussed the quality of medical education and training [3–5]. But all common arguments seem to be unilateral and do not go into depth of the problems of the students

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and look even less into possible solutions and advances. Therefore, this survey was conducted in order to study the learning behavior and the preferred learning strategies from the student's point of view.

"The environment that people live in, is the environment that they learn to live in, respond to, and perpetuate. If the environment is good, so be it. But if it is poor, so is the quality of life within it." from Ellen Swallow Richards.

The preparation for this project began in 2013. The first objective of our project group was to improve the level of knowledge transfer. During the initial discussion of this project, it was apparent that in order to do so, it is essential to gain a better understanding of the needs of the students. All the needs of the individual students and the academic teaching are inextricably linked [6, 7]. Bearing in mind that this study focuses on the student's needs, it represents just this part of the educational system [8]. According to the learning objectives, those results should subsequently lead to improved teaching and quality of the medical studies. An anonymous questionnaire was developed to evaluate demographic data and six different learning dimensions: time management, medical interest, learning methodologies, learning strategies, learning motivation, and learning appreciation.

Present research topics oftentimes cover individual aspects of the students' needs. Comparable studies were more commonly conducted in the area of adult education or business-consulting. Although findings from other disciplines may have some relevance, they cannot be transferred blindly due to the specific requirements of medical students.

Hillard [9], found in his research that the study methods are significantly determined by the assessment method. Multiple choice questions fostered rote memorization and surface learning, whereas free response written questions and clinical examinations encourage in-depth learning. The term "in-depth" or "deep-learning" is here used in opposite to superficial learning without an interrelated understanding [10]. An in-depth learning approach to studying is linked with academic success [11].

Learning styles are extensively discussed in current research. Pashler [12] concluded that "there is no adequate evidence base to justify incorporating learning styles assessments into general educational practice." The recent scientific findings do not provide any evidence in favor of one of the known learning style models [13].

Teaching has many different dimensions like expertise, technical performance, and joy of teaching or social skills [14]. All these depend on the education, experience and personality of the educator. On the one hand, expertise and technical performance can be easily evaluated and developed. The evaluation and development of didactic skills and joy of teaching or social competence on the other hand, is much more difficult [15, 16].

Information technologies provide a wide range of opportunities. E-learning has already become an extensive part of the education system [17–20]. It has the potential to provide benefit to academic learning [21]. With the introduction of new IT-systems, computer skills and acceptance of those systems were examined. Link [18] found that only a small percentage of students lack basic computer skills and/or are very skeptical about e-learning. About 12% make little or no use of existing e-learning offerings. Wynter [1] concluded that the increasing use of question banks raises the risk of poor alignment to medical school curricula. Han [22] summarized that students in the preclinical and clinical years need different educational technology.

Kılıç [23] assumed that learning differences between males and females could be related to motivation, authority orientation and responsibility. There are contradictory findings whether or not women and men have different learning orientations. Cultural differences do not play a significant role in students' preferred learning methods or learning styles [24, 25]. In adult education it is most important to achieve the expected goals and the ability to put the knowledge into practice. Adults are in general more open for different didactic methodologies and they therefore endorse non-conventional procedures [26].

2 Methods

The Faculty of Medicine at the University of *Graz)* was established 1863 and became an independent university in 2004. The degree program is limited to 336 students per year for human medicine and 24 for dental medicine. Due to an entrance exam the dropout rate is less than 10% and more than 82% complete within the designated time plus one semester.

From 2014 to 2019 an anonymous questionnaire was sent to all medical students by e-mail (students' account) once a year. They had one month to complete the survey. EvaSys Ver. 7.1 (Electric Paper Evaluationssysteme GmbH Lüneburg, Germany) was used for sending the link to the online-questionnaire by e-mail and to administrate the results.

The questionnaire was sent to 14916 students in total (2486 per year). The number of completed questionnaires was 2799, which resulted in an annual response rate of $18 \pm 4\%$. The e-mail contained an information notice regarding the project and a link to the questionnaire. The online questionnaire was structured in seven sections: demographic data, time management, medical interest, learning methodologies, learning strategy, learning motivation, and learning appreciation – in total 41 questions (including four free text questions) were asked. To avoid even the slightest impression of judgement and manipulation no ordinal or metric scales were applied [27].

To evaluate the free text questions the ranking of the frequently used words (term frequency) were evaluated visually as table- and as bar-chart – also separately filtered for male and female. In case the context of the investigated words was crucial, all text passages for this specific word were analyzed.

The data from EvaSys are available in the form of an ASCII files in CSV format. Python (Version 3.7.1) [28] under Jupyter Notebook (Version 5.7.0) [29] were used to calculate and display the numerical and statistical results. Pandas (version 0.24.2) [30] were used as a data analysis library. Numpy handled the data arrays (version 1.16.4) [31]. Matplotlib (version 3.1.0) [32] was used as plotting library.

The curriculum for medical students is structured in three study sections. The first section lasts two years, and covers pre-clinical subjects, fundamental knowledge and comprehension, and the basis for the cause of the disease, professional doctor-patient interaction and includes a clinical internship. The second study section lasts 3 years and provides putting their theoretical knowledge into practice within the clinical context. The purpose is to be able to explain and apply clinical skills. It covers the different clinical disciplines, as a base for scientific work, psychology, ethic and law. The last section

lasts for one year and is the "clinical internship year" and the program concludes with a diploma thesis. The entire course is scheduled for a duration of 12 semesters.

The data arrays were filtered for gender and for the academic years in groups of the first two years (first and second year – preclinical students), the subsequent four years (until the 12th semester – clinical students), the following three years (clinical internship students) and a separate group for students beyond (long-term students).

The last question was adopted from Steve the Shazer. He invented the miracle question for the solution-orientated brief therapy. The miracle question has the advantage to focus on the solution instead of the problem. It is well suited to substantiate the desired states and express the necessary steps to reach those [33].

3 Results

Demographic Information

The gender distribution of respondents to the online survey was 51% (1433) female and 49% (1366) male. The students per group were 1225 preclinical students, 1233 clinical students, 291 clinical internship students, and 50 long-term students.

The majority, which consists of 37% (1029) of the students, did not work during the semester. This decreases from 42% for preclinical students, 30% for clinical students, 29% for clinical internship students to 13% for long-term students. Students who only worked during their holidays also decrease from 39% for preclinical students, 28% for clinical students, 24% for clinical internship students to 14% for long-term students. The number of students who worked half-time increased from 13% for preclinical students to 30% for preclinical students, 29% for clinical internship students, and 47% for long-term students. A minority of 3% worked more than half-time and 5% worked in the evening or at night.

Time Management

The majority, which consists of 38% (1066), had enough time to study and 37% (1048) experienced stress before exams. The remaining percentage of 24% (685) claimed that they have too little time to study. Within the first 2 years of their studies, 44% of the male and 30% of the female students had the feeling they had enough time and 36% male and 45% female students experience stress before exams – 20% of the male students and 25% female students did had too little time for their study. These gender differences aligned in the higher semesters.

The majority, which consists of 68% (1901) started to study a few weeks before an exam, 22% (602) study on an ongoing basis with a short preparation period before an exam and the remaining 11% (296) studied and learned on an ongoing basis. The most efficient time to study was before noon (43% female, 34% male), followed by the night (25% female, 32% male). While more females (18% female, male 14%) preferred the early morning and more males 21% (14% female) preferred the evening.

Medical Interest

The preference for specific medical disciplines rose during academic training. For the first two years, this was 56% (686) and increased to 79% (971) for clinical students and 86% (251) for clinical internship students. In total 30% (850) of the students did not choose a specific discipline. The highest interest level was 19% in internal medicine followed by 17% for surgery and 15% for other medical divisions (e.g. cardiology, endocrinology, hepatology), 6% for general medicine (without specialization), 4% for neurology, 3% basic medical disciplines (e.g. anatomy, physiology, cytology), and 2% for diagnostic medicine (e.g. in-vitro diagnostic, radiology, nuclear medicine) and 2% for medical research. In total 52% (1460) of the students (55% female, 46% male) had only gotten a rough vision about their future professional practice. A percentage of 28% (796) had a fairly clear and precise vision, 10% (270) of students had a clear and precise vision and the remaining 10% (273) had not even a rough vision about their future professional practice.

A free-text question asked for the main strengths for the professional practice as a physician. The most important group of characteristics mentioned was "empathy" (766 times) and "social competency" (385 times). Secondly "know-how" and "expertise" was mentioned 650 times followed by "calmness" and "patience" for 300 times and "endurance" and "perseverance" mentioned 291 times.

Learning Methodologies

As best teaching setting – classroom-teaching style was claimed in 5% (145) while a mixture of classroom teaching and practice dominates with 66% (1884). The remaining 28% (770) voted for a practical clinical setting. For 86% (2397) of the students new topics should start with an overview to provide orientation, 8% (230) would like to start a new topic with information about the latest research findings and 6% (172) would like to hear important details and features about the new subject first. 65% (1826) of students believe that patient cases which are used for training should contain all the relevant information and 30% (844) of students are satisfied using cases mixed with complete and with incomplete patient records. Only 5% (129) chose incomplete and therefore more practical patient records for their training. For didactic teaching-cases 54% (1521) voted for complete information of cases and 46% (1278) voted for incomplete and therefore more practical cases – this rises from 50% for preclinical students and 56% for clinical students up to 64% for clinical internship students. The preferred time to obtain additional information about a case study is debriefing for 54% (1511) of students. For 19% (532) it is in a preparatory discussion and for 27% (758) it is during the presentation of the case.

A contemporary association between theory and practice was important to 60% (1754; from 64% for preclinical students, 60% for clinical students to 55% for clinical internship students and 47% for long-term students). Additional case studies were required by 15% (436; rising from 11% for preclinical students, 14% for clinical students up to 21% for clinical internship students). The discussion with experts stayed at 6% (171) during the whole study. To build skills and competences 43% (1199) voted for independent work under supervision. Second choice with 27% (754; 29% female, 23% male) was to work under guidance and 16% (446; 18% female, 13% male) are interested in attending case discussions. The remaining percentage of 7% (201) saw exhaustive