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Education of Molecular Biological Methods as Part of Medical Laboratory Programs

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Abstract: Medical laboratory programs are important courses that provide associate degree education for intermediate technical staff who will later be employed in healthcare services. As part of the curriculum, students in this field are trained in molecular biological methods in the spring semester of their second year. The course aims to teach methods for isolating DNA from different biological materials, such as human blood, tissue samples and amniotic fluid, to teach the theoretical steps of the PCR (polymerase chain reaction), which is the basic method used for the amplification of the DNAs obtained, to allow students to practice the PCR method in the hospital's practice laboratories, to provide theoretical lectures on methods for preparing agarose tanks and gels, applying DNA into agarose gel and migrating and visualizing DNA, and to allow students to apply these methods in student laboratories within vocational health service schools. In addition, different PCR-based molecular biology methods and in particular, techniques routinely applied in healthcare services are included in the program's curriculum, and practical training of techniques and methods within the practical infrastructure of university hospitals is also provided. In our healthcare system, the presence of molecular medicine laboratories in both private and government institutions and the necessity of having equipped technical staff in these fields has rendered molecular biological method training a necessity. In conclusion, the combination of theoretical and practical training in the teaching of molecular biological methods increases the employment rate of students in our healthcare system after graduating from the program.

Keywords: PCR, Agarose, Amnion

Introduction

According to 2008 data, the number of vocational schools in Turkey rose by 47% from 547 to 802 in 2014. Of these schools, 705 or about 88% are in state universities, 57 or about 7% are in foundation universities, 8 or about 1% are in Foundation Vocational Schools, and 32 or about 4% are in other vocational schools. 549 of these Vocational Schools offer social and technical educational programs, while the remaining 253 schools provide education in 20 different thematic areas such as health, tourism, aviation, law, mining, and transportation.

The number of students studying in associate degree programs reached 1,527,706 in 2013 when those studying in associate degree programs of open universities are included. In other words, about 30 percent of the students in higher education go to Vocational High Schools.

Approximately 90.6% of the 777,741 students who are enrolled in Vocational High Schools study at state universities, 5.7% percent at foundation universities, while the remaining 0.9% and 2.8% study at foundation Vocational High Schools and other Vocational High Schools. As of 2012-2013, there are 14,985 instructors at Vocational High Schools, including 2,171 faculty members. At Vocational High Schools, there are 358 students per faculty member and 52 students per instructor. At a time when the number of students per faculty member is rising, Vocational High Schools find themselves in a position where the quality of the education they provide is

being questioned. At the same time, the tendency to constantly open new programs due to the not-so-strict eligibility criteria, brings with it the necessity to reevaluate parameters such as infrastructure, technical staff and quality (1).

When 2013 data was analyzed and 10 associate degree programs were examined, it was seen that health education programs occupied the top 4 places on the list of the most preferred programs. In addition, the Medical Laboratory Techniques and First Aid and Emergency Aid Programs within the Health Services Vocational High School had the highest number of students (2,3).

Table 1: Programs and the number of candidates preferring these programs

Name of Program	Number of candidates preferring the program
Child development	393,976
First Aid and Emergency	378,626
Medical Laboratory Techniques	370,750
Anesthesia	332,711
Computer programming	321,009
Law	269,168
Banking and insurance	224,710
Accounting and tax practices	221,531
Foreign trade	180,585
Business management	159,686

While the course content of the Medical Laboratory Techniques program within the Health Services Vocational High School has an undeniable impact on these figures, it is also an incontestable fact that having well-qualified technical staff is a serious asset. When preparing the course catalogues for the Medical laboratory techniques program, it is of utter importance that the molecular biology methods course, which many universities have been incorporating into their curriculum since the 2000s, is delivered in an efficient and engaging way with all important aspects covered. Unfortunately so far, there has not been a successful initiative to establish a standard course catalog, a standard course content or standard course hours for the Health Service Vocational High Schools across Turkey. Therefore, students transferring to other schools are not able to take the courses they desire, which is also the case for those wishing to take courses from other universities during summer school. This is either due to the incongruencies between their European Credit Transfer System or because the course contents do not match (2,4).

This aspect alone even further increases the Health Service Vocational High Schools' student population as well as the number of students per faculty member with many students not being able to finish the programs within the designated period of 2 years due to these reasons.

Consisting of 3 hours of theoretical and 2 hours of practical sessions, the molecular biology methods course in the medical laboratory techniques program is usually taught to students in the 2nd semester (spring term). Students firstly engage in practical training activities at a Health Services Vocational High School laboratory built specifically for that purpose while at later stages they participate in internship programs at hospitals to further their practical skills. As there are unfortunately an excessive number of Health Service Vocational High Schools across Turkey due to the above-cited reasons, the molecular biology methods course is a key course offered by the medical laboratory techniques program and preferred by a large number of students. Unfortunately these schools lack in most cases the essential practical training at student laboratories, with the sole focus being on theoretical considerations. This is of concern as students taking the molecular biology methods course must acquire a basic understanding of concepts such as the structure and properties of nucleic acids, the mass of genetic material, the base content and base sequence, the form and organization of genetic material, organization of genetic material in viruses and viroids, organization of genetic material in prokaryotes, organization of genetic material in eukaryotes, enzymes of the nucleic acid metabolism, DNA replication in prokaryotes, DNA replication in eukaryotes, replication mechanisms in viruses and viroids, repair systems, the gene structure, transcription and translation and the genetic code. In this course, it is essential that theoretical teaching must be supplemented with practical training. The laboratory course aims to teach classical and molecular genetic techniques to students in a practical setting. These techniques include methods such as DNA

isolation and agarose gel electrophoresis, PCR and RFLP, DNA sequencing analysis, Total RNA isolation, RT-PCR, chromosome analysis, Monohybrid, dihybrid and backcrossing, Polytene chromosome, DNA isolation and quantitative analysis; DNA sequence analysis; PCR-SSCP (Polymer-Chain Synthesis-Single-Chain Conformation Polymorphism) scanning technique; Southern blot and cloning in the bacterial system, isolation and purification of DNA and RNA molecules, qualitative and quantitative analyses, replication, hybridization methods and polymorphism analysis (5).

In the molecular biology methods course, basic technologies should be taught both theoretically, and also practically in a lab setting; however, since most universities lack the appropriate facilities, most students visit biochemistry, microbiology and genetic diagnostic laboratory units at the central labs within university hospitals to compensate for the shortcomings in their practical education.

Conclusion

To conclude, it is extremely important that students get the most they can out of the molecular biology course, which is a compulsory course in the medical laboratory techniques program. With the use of genetic diagnostic methods to diagnose diseases in recent years, and with clinicians starting to take into account genetic data besides biochemical parameters to make a diagnosis, there is now a greater need for technical health staff who are well-acquainted with the methods in molecular biology. On this basis, it is crucial that the molecular methods course has both a theoretical and practical component.

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