University of Rijeka

School of Medicine

Lidija Bilić-Zulle

Prevalence and attitudes toward plagiarism

among medical students

Doctoral dissertation

Rijeka, 2006

Mentor: Prof. Mladen Petrovečki, M.D., Ph.D.

Doctoral dissertation defended on _____

at _____, before the committee members:

    1. _____

    2. _____

    3. _____

    4. _____

    5. _____

The dissertation is _____ pages long.

UDK: _____

Acknowledgments

To my parents, Adela and Slavko, and my husband Kristijan.

Because of your love I can move the world.

Prevalence and attitudes towards plagiarism among medical students

Summary

Aim. To determine the prevalence of plagiarism among medical students and investigate students' attitudes towards academic integrity and intellectual property.

Subjects and methods. During three academic years, 295 second-year medical students (63% women) attending a mandatory course in Medical Informatics wrote an essay based on one of four source scientific articles. Their essays were examined by *WCopyfind* software for plagiarism detection and the extent of plagiarism was calculated. The first sample of students was warned that the essay was expected to be an original paper, the second sample was strictly prohibited to copy, and the third sample received an additional warning that the essays would be examined by plagiarism detection software and that students who had plagiarized would be punished. In the second part of the study, students' attitudes towards six fictitious scenarios were investigated. The scenarios consisted of a case of self-plagiarism, three cases of plagiarism (copying an essay from a fellow-student with and without his or her consent and a professor copying from his junior associate), a case of cheating on an examination, and a case of a physician issuing a false medical report. Finally, general attitudes towards intellectual property and academic integrity were examined by a six-item questionnaire.

Results. The average extent of plagiarism was 7% (5th-95th percentile = 0-84%). Students warned about the use of plagiarism detection software and the consequent penalties plagiarized less (2% vs. 17% vs. 21%, P < 0,001). Although the fictitious plagiarism cases were considered inappropriate by majority of students (67-90%, depending on case), a quarter to half of them found these acts justified. The majority of students (65%) found the case of self-plagiarism to be appropriate and deserving no penalty (79%). A quarter of the students found the case of cheating appropriate and half of them thought it was justified and deserved

no penalty. Approximately half of the students (39-66%) would act as described in the scenarios, if they deemed it to be necessary. In addition, 33-45% reported to have witnessed similar cases in their environment. Attitudes towards academic integrity in two-thirds of students could be described as appropriate. The discrepancy between student behavior and attitudes implied that some answers were given as socially desirable.

Conclusions. Plagiarism is present among medical students. If there is no plagiarism detection software and penalty threat, plagiarism among students may be expected. Medical students' attitudes toward academic integrity are disturbing. Students need clear guidelines and further education on academic and scientific integrity.

Key words: Ethics, Medical; Fraud; Intellectual property, Copyright; Plagiarism; Scientific Misconduct; Students, Medical

Content

1. Introduction

1.1. Science and integrity

Science, research, and a scientific way of thinking are an essential part of today's civilization. Scientific achievements provide the basis for advancements in all fields of human activity (1). According to its four basic qualities, science is "the source of real knowledge for the entire humanity," "part of culture," "a key element of the educational system", and "it contributes to the well-being and safety in everyday life" (according to Marušić M, 2004) (2). Today, probably more than ever, scientific research and reports of its progress pique the public attention. Due to the fast development of technology and the media, scientific findings quickly find their use in our everyday life; in the field of medicine, they have a direct influence on human health and life (1,2). Although a large part of scientific research, especially basic science research, may not a direct impact on everyday life, it may serve as a basis and incentive for further studies whose findings will, in time, directly influence our life. Because of its importance to society, one of the most important elements of research and a cornerstone of science is – integrity (1-3).

Scientists do not have higher integrity than other people. As Jim Gilles writes in *Nature* (4), scientists lie, cheat, and steal just like everybody else. However, their work is public and can be checked after it is published (2,5). A scientific paper becomes a permanent legacy and will forever be open to review and critique. Dishonest scientists, if caught in their dishonest acts, tend to lose their respectability, trustworthiness, and membership in the scientific community (6,7).

With the growth of science and increase in the number of scientists and scientific publications, scientific misconduct has also become more frequent. In the early 1980's, the question of scientific fraud became a public issue, especially as more and more cases of scientific fraud came to light in the United States of America (USA). Until then, scientific misconduct was considered an internal problem of scientific and academic institutions. However, with the increasingly important role and influence of science in society, especially biomedical sciences, the problem of scientific misconduct became a public issue. In the late 1980's, the United States Department of Health and Human Services and other health-related governmental bodies opened an office whose task was to monitor research misconduct. In 1992, the Office of Research Integrity (ORI) was founded as part of the Office of Public Health and Science within the Office of the Secretary of Health and Human Services. The purpose of ORI is to promote integrity in biomedical research, establish criteria of good clinical practice, develop recommendations and guidelines for education in scientific integrity, and investigate cases of scientific misconduct in the field of biomedical sciences (8).

To prevent and detect misconduct in science, we must be able to recognize and learn about different forms of scientific misconduct not only to reveal it in the best interest of science, but also to draw the attention of scientists and, especially, students who are just getting their education, so that acts of misconduct are not committed out of ignorance (9). The three most severe forms of scientific misconduct are fabrication, falsification, and plagiarism. While fabrication and falsification of results are more tightly linked to the research itself, plagiarism as one of the most dishonest forms of scientific misconduct can be committed in any phase of scientific work and at any level of education (6,10,11).

1.2. Plagiarism

The definition of plagiarism is still a controversial and highly debated topic; however, the consensus opinion today is that plagiarism is unauthorized appropriation of another's work, ideas, methods, results or words without acknowledging the source and original author (7,12-14). Plagiarism is essentially a theft, and in some cases, a criminal act (particularly if it violates copyright), and as such subject to legal action and punishment (10,15,16). Plagiarism goes against the basic principles of science. Results and reports that contain plagiarized – stolen – data, ideas or words are useless, misleading, and do not contribute to science, but at the same time they bring undeserved benefit to the perpetrator. Although unethical, dishonest, and prohibited, plagiarism is doubtlessly present in the scientific and academic community (6,17,18). The confirmed cases of plagiarism from 200 years ago show that it has, unfortunately, always been present in science reporting (19).

In addition to plagiarism, self-plagiarism – plagiarizing one's own words, ideas, or results and presenting them as original work – is an equally dishonest act (20-25).

1.2.1. Plagiarism in biomedical sciences

The importance and seriousness of the problem of plagiarism in biomedical sciences is shown by the fact that the word "plagiarism" was included in the Medical Subject Headings thesaurus in 1990 (*http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?CMD=search&DB=mesh*) and in the number of journal articles under that descriptor. According to the *PubMed,* search engine of the National Library of Health, *Medline* database contains 442 citations under the descriptor "plagiarism", 61% of which have been published in the last 10 years. A *Google* search with a key word "plagiarism" results in more than 22 million links to websites containing the word "plagiarism" in some context. Journal editors warn of the seriousness of the problem of plagiarism. Although they cannot take the responsibility for the dishonest behavior of authors, journal editors can and do develop different strategies within the review process to prevent publication of plagiarized manuscripts. Some journals, like *Croatian Medical Journal,* even appoint research integrity editors (26-28).

In the biomedical sciences, the attention is especially focused on detection and prevention of plagiarism and other forms of scientific misconduct due to the importance of biomedical research and of consequences that such acts can have on human health and life. Furthermore, there are indications that plagiarism in biomedical and natural sciences is more frequent than in humanities or philosophy (14). Perhaps for that reason, there appear to be greater efforts at detection and prevention of plagiarism in the biomedical sciences.

Plagiarism and other forms of scientific misconduct are being increasingly investigated by scientists of different background, biomedical journal editors, university instructors, and lawyers in scientific and educational institutions. The ever growing importance of scientific research and scientific integrity led to the first international *Research Conference on Research Integrity* organized by the Office for Research Integrity in Bethesda,

USA, in November 2000. Due to the interest and amount of research in that area, the conference has been traditionally held every two years since. There are also other scientific conferences and workshops focused on specific types of scientific misconduct, such as the *Conference on Plagiarism across the Science Disciplines,* which was held in New York University Medical Center, New York, SAD, in October 2005.

1.2.2. Plagiarism in the academic community

Promotion of academic and scientific integrity values is of the utmost importance in the academic setting, where future experts and scientists are being educated. Students must be warned of detrimental and damaging effects of plagiarism early in their education. Ignoring and accepting plagiarism among high-school and university students allows them to choose "the easy way out," i.e., to obtain credit in a dishonest way. The behavior pattern students acquire in school is likely to be the behavior pattern they will continue to follow in their professional life (29,30). Dishonest medical students are likely to become dishonest physicians. Copying and cheating on exams during the studies reflects insufficient medical knowledge (31,32). Although honesty and integrity are essential features of the medical profession as much as they are of scientific work, many medical schools are faced with serious breaches of academic integrity (30,31,33,34).

Due to the development and accessibility of computer technology and the availability of immense amount of information on the web, plagiarism is not difficult to commit. By use of a text editing program, i.e., a simple "copy/paste" command, another's words can be copied and included into one's own text, which may then be presented as one's original work. Although the opportunity to plagiarize has always existed, it is now easier to copy another's text if it is available in electronic format on the web. The practice of copying from documents

available online has created a new form of plagiarism, often referred to as "cyberplagiarism" (13,35-37). We can assume that the use of computers and the internet is the very reason why the prevalence of plagiarism has increased in the academic as well as in the scientific community; however, this statement is difficult to prove (13,36,38-40).

In spite of all the positive advantages of the internet for scientific and academic work, there are also many websites that make different forms of academic fraud possible (41,42). Some websites sell student essays, master's theses, and even doctoral dissertations as ready-made goods (for example, *http://www.essaysforstudents.com/* or *http://www.papers4you.com/*) or offer writing services, which consist of assembling parts of other already published documents into a new document based on a given title, key words, and chosen level of complexity (student essay, scientific report, master's thesis, or doctoral dissertation) (for example, *http://www.termpapersnreports.com/order.html*). Although most websites are in English, a sufficient amount of online content is now available in other languages too, including Croatian (for example, *http://www.knjigice.com* or *http://www.salabahteri.tk/*). Also, a frequent practice of many universities in the world, even in Croatia, is to post examples of student essays and reports on the university's website, making them open to plagiarism and easily exploited by dishonest students. It is important for teaching staff to know that such content is available online and that its abuse among students should be prevented (41).

1.2.3. Software for plagiarism detection

It is not easy to prove that plagiarism has occurred (10,28). Information technology has certainly made plagiarism easier to commit, but it has also made it easier to detect (24,43,44). Before the era of computers and electronic documents, detection of plagiarism was mostly accidental. Today, however, a simple use of search engines, such as *Google* (URL: *http://www.google.hr*), *Yahoo* (URL: *http://www.yahoo.com*), allows us to enter key words or parts of the text under investigation so that we may locate the original document, if it has been posted on the Internet, that was partly or completely copied (38,44). Moreover, several different types of software have been developed for the sole purpose of plagiarism detection (12,36,38,43).

A software program for plagiarism detection may use one of the several different types of analysis. Most programs perform basic text analysis by comparing two electronic documents and searching for matches (12). There are software programs and web-based programs that, in addition to text analysis, search the internet for documents containing the same word strings. The most famous web-based programs for plagiarism detection, especially in academic setting, are *Turnitin*® (iParadigms, Oakland, California, USA; URL: *http://www.plagiarism.org*) and *EVE* (Essay Verification Engine, CaNexus.com; URL: *http://www.canexus.com/eve/*). Both are used by many universities and allow detection of similarities between the analyzed document and documents available on the web or in a restricted number of electronic databases, online books and journals, and university databases of student essays (45). A disadvantage of these programs is that they can be used only in English setting due to language restrictions (adapted for English only).

However, there are some computer programs for plagiarism detection that can be used on any document irrespective of the language in which the document is written. One of such

programs is the *Glatt Plagiarism Screening Program* (Glatt Plagiarism Service, Chicago, IL, USA; URL: *http://www.plagiarism.com*), which uses the Cloze procedure to help determine whether an individual has plagiarized. This software replaces every fifth word in a student essay by a blank space. The student who wrote the essay is then asked to fill in the missing words. If less than 77% of the words the student filled in match the original words, there is a high probability that the student copied rather than wrote the text him or herself (12). Using this technique, it is possible to identify every essay that for whatever reason was not written by the student who submitted it as his or her own, including bought, copied, or downloaded essays.

One of the software programs for plagiarism detection is *WCopyfind.* It can be downloaded from the website of University of Virginia (*http://plagiarism.phys.virginia.edu/ Wsoftware.html*) free of charge. It was developed by Professor Louis Bloomfield, Department of Physics, University of Virginia, after he had received an anonymous note from a student saying that students were copying exam essays from students who had taken the same course in the previous semester (46). *WCopyfind* program compares two or more text documents with one another and identifies matching phrases. The program does not search the internet or electronic databases for the original document, but compares the documents chosen and provided by the user. In this way, student essays can be compared quickly and efficiently not only against the original document assumed to have been used as a source for the student essay, but also with one another. Due to the latter option, student essays can be checked for plagiarism against the essays of the previous generations of students (47). The advantage that *WCopyfind* has over other software programs is that it can be used for analysis of documents in languages other than English as long as these use Roman alphabet letters. Of course, the documents being compared must be written in the same language. Until today, no software has been developed that could efficiently compare for plagiarism documents written in

different languages, which is the reason why plagiarism by translation cannot be easily detected.

Use of the software for plagiarism detection is limited only to plagiarism of words. Plagiarism of ideas, methods, and results, if no plagiarism of words is present, cannot be detected and proven by use of software (48).

In use of software for plagiarism detection based on text matching, it is important to take into account the values of the parameters used by the software. One of the basic parameters that greatly influence the results of text analysis is the lowest number of consecutive matching words. This number determines whether a matching word string will be considered a word phrase or plagiarized text. In *WCopyfind*, the value of the "fewest matches to report" parameter can be set from 1 to infinite; however, according to different sources, the optimal value is 6. This is the usual number of words referred to in the literature on plagiarism as the "six-word rule" (24,47,49). Since the result of computer analysis in the comparison of two documents is most often expressed as the number of matching words or proportion of matching text, it is important to check the words that have been copied because the software defines the word as a string of characters between two spaces. The reason why all software programs for text analysis highlight the matching parts of the text is that the user can check and verify if the numerical result of text analysis is correct (38,45,47).

Manufacturers of computer programs for text analysis have also developed systems for plagiarism detection. New versions of these programs will allow for detection of parts of the text created by use of "copy/paste" command and the source from which they were copied; this option will facilitate detection of direct plagiarism immensely (36).

1.2.4. Student attitudes toward plagiarism and other issues of academic integrity

The prevalence of plagiarism largely depends on the cultural characteristics of the academic (student) setting, the degree to which that setting implicitly allows or explicitly accepts plagiarism, and the attitude toward it, i.e., how wrong it is to plagiarize, especially if there are "good reasons" for it (31,50-54). Different societies have different attitudes toward plagiarism; however, it is significant that plagiarism among students is generally considered a less serious offense than cheating on an exam or other similar acts (40,55-57). It seems that students sometimes commit plagiarism inadvertently and out of ignorance. They often do not know that they have to cite the author, source, and literature they consulted while writing their essays or reports. For that reason, universities in many countries have created explicit and readily available guidelines on writing reports, supported by wide range of examples. Also, the acts considered to be plagiarism tend to be clearly defined, strictly forbidden, and severely punished (58-64). If combined with efficient methods of plagiarism detection, the likelihood that students will commit plagiarism is thought to be significantly reduced (65).

Croatian universities have neither clear and readily available rules against plagiarism nor penalties for such acts. The University of Rijeka has the Ethical Code, which contains two subsections related to scientific integrity in the subsection VI, Professional Rights and Responsibilities. One is the subsection 3, Research Ethics, and the other is subsection 5, Authorship on Scientific and Scholarly Publications (66). However, the Code does not contain clearly defined rules against plagiarism among students or penalties for breaches of the Code. According to the present author's knowledge, university instructors do not generally have their own plagiarism policies for their courses, at least not published or clearly defined. They also do not include an explanation of such an act and what its punishment would be, except for a general attitude according to Ethical Code.

However, at the professional level the situation is different. As of 2006, by the decision of the Ministry of Science, Education, and Sports of the Republic of Croatia, a statement on responsible conduct of research signed by the principal investigator has to be included in all research grant applications submitted to the Ministry (*http://zprojekti.mzos.hr/zprojektiold/download/Uzorak_projekt.pdf*).

The *Croatian Medical Journal*, the most respected Croatian journal in the field of biomedical sciences, has had a Research Integrity Editor on their staff for the last 5 years. The task of this individual is to prevent, in cooperation with other Journal editors, publication of articles that seem to breach the principles of scientific integrity (26,27). Consequently, teaching scientific methodology and integrity to medical students should give an important impetus to the promotion of honesty in science (67-71).

Yet, when it comes to academic setting, only a few steps in that direction have been taken. Croatian universities do not have clearly defined rules of academic integrity or specific penalties for breaches of existing rules, and student violations of academic integrity principles are almost never sanctioned. The absence of clear guidelines represents a serious situation because the punishment for students who have committed plagiarism or breached the principles of academic integrity in some other way contributes to the decrease in the prevalence of such acts. In addition, the influence of punishment is thought to also become culturally conditioned in the minds of students (65,72-79).

Before the formulation of rules against plagiarism and the development of a meaningful system of education on academic integrity, the prevalence of plagiarism among students and student attitudes toward breaches of academic and scientific integrity should be investigated, as well as their attitudes toward intellectual property, punishment for misconduct, and reporting of misconduct.

A research project supported by the grant No. 0062044 of the Ministry of Science, Education, and Sports, titled "Prevalence, characteristics, and attitudes toward plagiarism in medicine", headed by Prof. Mladen Petrovečki as the principal investigator and approved in 2002, is the first research project in Croatia that systematically investigates plagiarism and other forms of scientific and academic misconduct. The aim of the research project is to provide scientific evidence of the forms and prevalence of plagiarism, based on quantitative measures of plagiarism. Such issues have never been investigated in Croatia and they are important to the international biomedical community. In Croatia, there are no such data. Discussion on the attitudes of members of scientific and academic community, whether authors plagiarize with bad intent or because they do not know the principles of scientific methodology and research integrity, is important for the implementation of preventive measures, which include the development of clear guidelines against plagiarism similar to those existing at many universities worldwide.

The present study is part of the abovementioned project. The general aim of the study is to determine the prevalence of plagiarism among medical students and student attitudes toward different forms of plagiarism and scientific misconduct, with the purpose of contributing to the development of the basis for university guidelines on responsible studying and learning, especially for medical students whose responsibility is all that greater as their work and knowledge will have direct implications on human life.

2. Aims

Specific aims of this study were as follows:

2. to determine the prevalence of plagiarism among medical students by use of student essays based on the given scientific articles;

3. to determine if there was a difference in prevalence of plagiarism among three groups of students: those that received a clear warning against plagiarizing text from the source paper, those that received no such warning, and those that were clearly warned that their essays would be checked for plagiarism and the students who plagiarized would be punished;

4. to determine the attitudes of medical students toward different forms of plagiarism and scientific misconduct;

5. to examine the attitudes of medical students toward research and academic integrity and intellectual property; and

6. to determine the possible differences in prevalence and attitudes toward plagiarism among students with respect to their sex and academic achievement.

3. Subjects and methods

3.1. Subjects

The study included all second-year students of Rijeka University School of Medicine who attended a mandatory course in Medical Informatics during the 2001/2002, 2002/2003, and 2004/2005 academic years (the study was not conducted in the 2003/2004 academic year). The total number of students was N=295. There were 187 (63%) women and 108 (37%) men. The median age of all students was 21 years, ranging from 19 to 27. Table 1 shows the number, age, and sex distribution of the students in each academic year. There was no statistically significant difference in the number, age, and sex distribution among three samples of second-year students included in the study.

Table 1. Number, age, and sex distribution of second-year medical students in the three academic years

Academic year	Number of enrolled students	Statistical analysis [a]	Sex		Statistical analysis [b]	Age median (range) in years	Statistical analysis [c]
			male N (%)	female N (%)			
2001/2002	114		44 (39)	70 (61)		21 (19-27)	
2002/2003	88	χ^2=1.84 P=0.391	27 (31)	61 (69)	χ^2=1.93 P=0.381	21 (20-26)	H=3.69 P=0.123
2004/2005	93		37 (40)	56 (60)		21 (19-26)	
Total	295		108 (37)	187 (63)		21 (19-27)	

[a] The number of students in three academic years was compared by χ^2-test.
[b] Sex distribution of students in three academic years was compared by χ^2-test.
[c] Age distribution of students in the three academic years was compared by Kruskal-Wallis test.

The study of the prevalence of plagiarism among students and their attitudes toward this type of academic misconduct was performed during the Medical Informatics classes. Student participation in the study was voluntary and anonymous. The students were informed

about the study at the beginning of the course. The study of prevalence of plagiarism among students was based on the analysis of student essays, which were mandatory as part of the course, whereas student attitudes toward six different forms of scientific and academic misconduct were examined by use of anonymous questionnaires that were distributed over six practicum sessions. General attitudes were examined by use of anonymous questionnaires given after the Medical Informatics examination.

During the Medical Informatics course in the three academic years, 5 students dropped out of school: 3 students dropped out in the 2001/2002 academic year (two female and one male student), one male student dropped out in the 2002/2003 academic year, and one female student dropped out in the 2004/2005 academic year. These 5 students participated in the part of the study that investigated student attitudes toward plagiarism, which was conducted by use of anonymous questionnaires, but were not included in the part of the study that investigated prevalence of plagiarism since they had not written and submitted their essays. Thus, the final number of students in the part of the study investigating the prevalence of plagiarism was 290, whereas 295 students participated in the part of the study investigating student attitudes.

3.2.   Methods

The study consisted of three parts.

During the first part the prevalence of plagiarism was investigated in student essays on the given topic by use of software for detection of plagiarism.

During the second part student attitudes toward different forms of plagiarism and academic misconduct were investigated by use of anonymous questionnaires containing items about six different cases of dishonest academic, scientific and professional behavior.

And during the third part of the study general attitudes of students toward scientific and academic integrity and intellectual property were investigated by use of anonymous 6-item questionnaires applied after the Medical Informatics examination.

3.2.1. Prevalence of plagiarism study

3.2.1.1. Student essays

The prevalence of plagiarism among students was investigated on student-written essays that are a mandatory part of Medical Informatics practicum. The essays are not graded and do not influence the final grade. The aim of writing an essay is for students to practice writing by using *MS Word* software (Microsoft Corporation, USA) according to strictly defined rules of essay formatting. Students were instructed on how to write an essay during classes and the instructions were posted on the webpage of Medical Informatics Department (Table 2).

Students were offered to choose one of the four scientific articles written in Croatian to use it as a source paper for writing an essay. The articles were published in Medical informatics '99 – Proceedings of the 4th Symposium of Croatian Society for Medical Informatics, edited by Kern J, Hercigonja Szekeres M; Croatian Society of Medical Informatics 1999 (UDK 61:81.3, ISSN 1330-1799) (Table 2). Two of the four source articles were available only in hard copy format, whereas the other two were available in electronic format on the Medical School's website. Topics of one article in hard copy format and one in the electronic format were considered to be less complex, whereas the topics of the other two articles were considered more complex according to the topic. Complexity of the topics was estimated by the course instructor (L.B.Z.) based on subjects covered and explained during the course of Medical Informatics. Students were asked to write an essay on the topic discussed in the article they chose. Use of additional literature sources was not explicitly prohibited.

Table 2. Instructions for student essay formatting

General instructions	Essays should be based on the given article published in a professional or scientific journal from the field of medical informatics. The purpose of the essay is to show student's critical thinking skills and understanding of the topic of the article, i.e., a student should write a short review of the problem described in the article using his or her own words rather than copying the thoughts of the author of article.
Articles offered	- Lukačić Z, Kern J, Težak-Benčić M. Detection of predictors of newborn survival by use of expert system based on the fuzzy logic model [in Croatian]. Proceedings of the 4th Symposium of Croatian Society for Medical Informatics; 8 Nov 1999; p. 83-8. - Magjarević M, Tonković S, Kovačić D, Lacković I. Telemedicine in Croatia – reality or distant future? [in Croatian]. Proceedings of the 4th Symposium of Croatian Society for Medical Informatics; 8 Nov 1999; p. 97-103. - Petrovečki M. Problems of the medical classification and coding systems in teaching medical informatics [in Croatian]. Proceedings of the 4th Symposium of Croatian Society for Medical Informatics; 8 Nov 1999; p. 113-9. *Available in e-format.* - Bilić-Zulle L, Petrovečki M. Evaluation of medical informatics education at Rijeka University School of Medicine [in Croatian]. Proceedings of the 4th Symposium of Croatian Society for Medical Informatics; 8 Nov 1999; p. 121-6. *Available in e-format*
Instructions for essay formatting	The text should be written by use of *MS Word* software (Microsoft Corporation, SAD). The final format of the essay should be ready to print on a standard paper format (A4, 210×297 mm). The margins should be 2.5 cm, the text double-spaced (28-32 lines per page), and the font size 11-12 pt, supporting all Croatian letters. Pages should be numerated starting from the first page, with the page number in the middle bottom of the page. Essay should be 2-5 pages long, i.e., between 250 (minimum) and 2500 (maximum) words long.
Instructions on essay design	The first page of the essay should contain the following data in the header with left alignment: first and last name of the student, year of birth, student record number, date of creation of the text, name of the course, essay title, and source. The body text should start on the second page, with additional instructions if needed. Additional literature, if used during essay preparation, should be listed at the end.
Instructions on essay submission	Essay should be submitted to the instructor – teaching assistant in electronic format only, either saved on a floppy disc or sent as an attachment to the instructor's email address.

The study was performed in the same manner each academic year and the same instructions on essay writing were used. Each student sample was informed about the importance of using their own words and thoughts (as opposed to copying from other authors) while writing the essay; however, each sample received a different warning against plagiarism.

In the 2000/2001 academic year, students were clearly informed, while receiving instructions on writing, that the essay should be their original intellectual creation. Students in the 2001/2002 academic year were explained what plagiarism was – that it was unauthorized appropriation of other person's intellectual property, text, or part of the text – and explicitly

warned against plagiarizing while writing their essays. In the 2004/2005 academic year, in addition to being warned against plagiarism, students were told that all the essays would be checked by use of plagiarism detection software and that those who plagiarized from the chosen source article were to be denied the instructor's signature, which verifies their regular attendance of Medical Informatics classes.

3.2.1.2. Determining proportion of plagiarized text by use of *WCopyfind* software

Essays in electronic format were collected from the students during the Medical Informatics classes and prepared for text analysis to determine the proportion of text copied from the source article. Student (author) data, title of the essay, title of the chosen article, and possible literature list were removed from the essay and only the body text was used in analysis. The total number of words was counted by use of "word count" tool in *MS Word 2002* (Microsoft Corporation, USA). The "find and replace" editing tool in *MS Word* was used to replace Croatian diacritical signs by corresponding international signs ("č" and "ć replaced by "c", "đ" by "d", "š" by "s", and "ž" by "z") in both essays and source articles, because *WCopyfind* software does not support Croatian letters containing diacritical signs. Tables and figures found in 28 (10%) student essays were also removed, because *WCopyfind* software cannot analyze tables and figures.

 WCopyfind version 2.2 (47), created by Louis Bloomfield, was used to compare the students' essays to their corresponding source articles. The program compares two or more text documents by searching for matching word strings. The result of such text analysis is an absolute count of words in phrases that are identical in both texts.

 WCopyfind comparison rule parameters, presented in Table 3, were set according to the author's recommendations and literature sources (47,49).

Table 3. *WCopyfind* comparison rule parameters used in text analysis of student essays

Comparison Rule Parameter	Parameter Value	Interpretation
Shortest phrase to match	6	The program ignores matching phrases that are 5 words long or less
Fewest matches to report	1	The minimum parameter value that can be entered, which defines the lowest number of matching words in compared documents that will cause *WCopyfind* to create a report file. If the number of matching words is lower than this value, the program will not create the report file.
Shortest text string to consider	100	This value disables interference caused by special characters in the text, which are not printable (do not show in printout hard copy).
Most imperfections to allow	2	The number of subsequent non-matching words within in a perfectly matched phrase, which allows the program to "bridge" the non-matching part and connect matching pieces.
Minimum percentage (%) of matching words	80	Allows the program to recognize perfect matches despite minor editing imperfections, such as typing errors.
Ignore all punctuation	yes	Allows the program to ignore punctuation when performing phrase matching.
Ignore numbers	yes	Allows the program to ignore number characters when performing phrase matching.
Ignore letter case	yes	Allows the program to ignore capital letters when performing phrase matching.
Skip non-words and skip words longer than _____ characters	no	Allows the program to skip words containing special characters (all except letter characters, hyphens, and apostrophes) and words containing a large number of characters (e.g., webpage address).

Before *WCopyfind* was applied in the analysis of student essays, it had been tested for reliability. To test the program for absence of matching, perfect matching, and matching of the four scientific articles used in the study with one another, the four scientific articles were compared each with itself, with one another, with a text related and a text unrelated to medical informatics; standard parameter values were used (Table 3). "Recommendations of the International Medical Informatics Association on Health and Medical Informatics Education" (in Croatian; available from *http://andrija.snz.hr/wnew/IMIA-preporuke-prijevod-pdf.*) were used as the text related to medical informatics, whereas "How Potjeh Sought the Truth", a fairy-tale by Ivana Brlić Mažuranić (in Croatian; available from *http://adria.fesb.hr/~irenic/ tocno/davnina.html*), was used as a text unrelated to medical informatics. Comparison of the

four scientific articles with one another and with other two texts revealed no matching phrases, whereas comparison of each text with itself showed an absolute (100%) match.

Each student essay was compared with the scientific article it was based on and absolute number of matching words was recorded. From the total number of words and the number of matching words in the essay, a proportion of copied text was calculated and expressed as a percentage.

Distribution of the student essay topics was evaluated with respect to the availability (electronic format or hard copy only) and complexity of the topics (less or more complex topics) of the scientific articles.

After completing the course, students took the final exam in Medical Informatics. Based on the exam results, students were divided into three groups according to their level of achievement. Students who passed the exam on the first attempt and got a grade of A (excellent) or B (very good) were classified as excellent students. Students who passed the exam on the first attempt and got a grade of C (good) or D (sufficient) were classified as average students, whereas those who failed the exam on the first attempt or did not take it at least for a year after completing the Medical Informatics course were classified as poor students.

The total number of words, number of words copied from the scientific article, and the proportion of the copied text in each student essay was analyzed with respect to the sex of the student, type of warning against plagiarism, availability of scientific article, complexity of the topic, and student achievement.

3.2.2. Assessment of student attitudes toward different forms of plagiarism

Student attitudes toward plagiarism and other forms of academic, scientific and professional misconduct were investigated by use of six imaginary but possible scenarios of misconduct. The scenarios were read to the students during the six practicum sessions. Each scenario described a different case of misconduct. After the scenario was read, the students were asked to fill out an anonymous questionnaire containing six multiple choice questions about their attitude toward the appropriateness and justifiability of the act described in the scenario and about the punishment that, in their opinion, the perpetrator deserved. Students were also asked if they themselves had done anything similar, if they would do anything similar, if they had any knowledge about such or similar real event, and if they had witnessed or participated in such an act (Table 4).

After the students responded to the first six questions in the questionnaire, they were read an epilogue to the scenario that described either the reversal of the situation or a similar act committed in more aggravating circumstances (Table 5). After the epilogue was read, the students were asked an oral, logical question, different for each scenario (Table 5).

All the scenarios were read by the same person (L.B.Z) to all the students included in the study over the three years of research, always in the same period (summer term, the same group distribution), in the same manner, and in the same order. The questionnaire for each of the scenarios contained the same questions.

Table 4. The content of the questionnaire used for assessment of the student attitudes toward each of the six cases of scientific misconduct

Question No.	Question	Offered answers
1	You consider the described behavior:	A – appropriate, B – wrong,
2	... and you consider it	A – justified. B – unjustified.
3	Should the person who committed the act be punished?	A – no. B – yes, the perpetrator should be: 1 – given an oral warning. 2 – taken away the benefit obtained by the act. 3 – expelled from school, i.e., excluded from health/scientific community.
4	Have you ever done anything similar to the described act?	A – no, because: 1 – I did not have the opportunity. 2 – I consider such an act unacceptable. 3 – I'm afraid of punishment. B – yes, because: 1 – I had a good reason to do it. 2 – I don't think I did anything wrong.
5	Would you ever do anything similar to the described act?	A – no, never. B – I would in exceptional situation, if there were a real and urgent need to do it. C – yes, always.
6	Do you have any knowledge of such or similar acts taking place in reality?	A – I have never heard of any similar act (I have no knowledge of any similar act). B – I have heard of such (similar) a case. C – I have witnessed or experienced it in my environment or participated in such an act.
7	Answer to question specifically related to each individual scenario. [a]	A – no. B – yes.

[a] The question No. 7 was specific for each scenario and read to the students after they had heard the epilogue. All these questions are listed in Table 5.

Although the order in which the scenarios were read to the students was randomly determined at the beginning of this study, they are presented here in order of increasing the severity of misconduct described. The severity of these misconduct acts was determined on a 1-6 score scale (increasing order from less to more severe misconduct) by 20 faculty members of Rijeka and of Zagreb University Schools of Medicine. The order of increasing severity of misconduct was based on the sum of these ratings. The examples of academic, scientific and professional misconduct described in the scenarios, in order of increasing severity of

misconduct, included self-plagiarism, plagiarism with author's consent, plagiarism without author's consent, plagiarism by the superior, cheating on an exam, and physician fraud – issuing of a physical examination report without having actually performed the examination of a patient (false medical record). The content of the scenarios describing cases of scientific, academic and professional misconduct and the question specifically related to each of the scenarios are presented in Table 5.

Table 5. The content of the six original scenarios used in the study

Case	Scenario	Epilogue	Specific question related to the scenario (question No. 7, Table 4)
Self-plagiarism	Damir is a final-year medical student. He has to write an essay as part of the exam in an elective course. He remembers that he has already written an essay on a similar topic when he was on the third year. Damir takes that essay, changes the title and conclusions to adjust it to the content of the elective, and submits it at the exam in the elective course.	After several years Damir, now employed as a scientist, publishes a manuscript in a respectable and indexed medical journal. After the manuscript was published, Damir completely changes the title, slightly changes the content of the manuscript, adjusts the conclusions, and sends the same manuscript to another respectable journal. This way he publishes a sufficient number of cited articles needed for his academic advancement and applies for the position of assistant professor.	Do you think this is right?
Plagiarism with author's consent	Mirna is a second-year medical student. She's an A student, a demonstrator, active in a student organization, and regularly attends classes. Due to her many obligations, she did not have enough time to prepare an essay for a regular course in the fourth semester on time. The essay is important because without it, she will not have the right to a profesor's signature verifying her regular attendance of the classes. So she asks her colleague from the third year if she can borrow the essay the colleague wrote the previous year. Mirna completely copies the essay, submits it as her own work, and obtains the right to signature.	Olivera, Mirna's colleague at the same year of medical studies, read several papers from the previous year while she was preparing her essay. Among them, she found the essay that Mirna copied. When she was submitting her essay, she noticed that Mirna's essay was a copy and reported it to the professor.	Do you think what Olivera did was right?
Plagiarism without author's consent – theft	Danijela and Jasna go to the same school and share a room in a student dorm. Danijela is an A student and owns a P.C. Not long ago she passed with flying colors an exam in a course for which she had to write an essay. Jasna is a B student. She got a scholarship and needs high grades to continue receiving the scholarship support. Jasna is taking the exam Daniela has already passed in the next term. She uses Danijela's P.C. to write her essay, finds Danijela's essay, reads it, and copies a large part of it to receive as high a grade as possible, which will enable her to keep the scholarship.	Danijela decides to publish her essay, because it will bring her additional points needed for internship application. However, Jasna tells her that she copied a large part of it and asks her not to publish the essay, because she does not want to risk anybody else realizing that she copied it.	If you were Danijela, would you publish the essay?

Table 5. – continued…

Case	Scenario	Epilogue	Specific question related to the scenario (question No. 7, Table 4)
Plagiarism by the superior	P.H. is a respectable professor writing a book in the field of his expertise. While working on one of the chapters, he remembers his student, Mark, who has developed and defended a diploma thesis under his mentorship. Mark's thesis covered the topic that professor now writes about in this chapter. So the professor copies a part of Mark's thesis and includes it unchanged in the chapter. The professor does not cite Mark as the author of this part or the text, since Mark used professor's earlier work to develop of his thesis.	Shortly after the professor's book has been published, Mark publishes a scientific article based on his diploma thesis. Editors of the journal where Mark has submitted his manuscript notice the similarities between Mark's manuscript and the professor's book and accuse Mark of plagiarism. Not only they reject his manuscript, but they also inform a wider scientific community about the event.	If you were professor P.H., would you admit that your former student is the author of the text and that you copied it from his diploma thesis?
Cheating on exam	Mark is a fourth-year student. By the end of the academic year, he has already passed most of the exams. To enroll in the next year, he still has to pass one small and, in his opinion, unimportant exam. Mark has not prepared for the exam, but he still takes it. During the written part of the exam, he manages to switch the test with his colleague who prepared well for the exam. The colleague replies to the questions Mark does not know the answer to, Mark passes the exam, and enrolls in the next academic year.	A teaching assistant notices the test switch. To avoid the investigation, explanations, and embarrassment, which could be exhausting, he decides to forget the whole thing and acts as if nothing happened.	Dou you think that the teaching assistant did the right thing?
Physician fraud – issuing a false medical report	Professor B.N. is an experienced physician at a hospital department of medicine. Mr. A.B., whom the physician knows quite well, is about to undergo a smaller vocal cord surgery, but before that he must be medically examined. The medical examination includes routine laboratory tests, ECG, and a general physical examination. Since the patient's laboratory findings and ECG are normal, Dr B.N., who knows that A.B. is usually in good health, does not perform the general physical examination of A.B. but writes a medical report stating all the findings are normal to spare his friend from one more, unnecessary, visit to hospital.	Mr. A.B. receives his medical records and sees that general physical examination findings are normal. His family physician copies the medical report into A.B.'s medical file, explains that it is important as evidence of his health status, and gives A.B. a surgical referral slip.	If you were Mr. A.B., would you tell your family physician that you were not examined by a specialist in internal medicine?

On the basis of the answers to items in the questionnaire about all the scenarios, the difference was tested between the distribution of attitudes toward appropriateness and attitudes toward justifiability of the act, attitudes toward deserved punishment, and answer to the logical question related to the epilogue of each scenario. An attitude was considered acceptable with respect to the principles of academic integrity (58,66), if all the described acts were considered inappropriate, unjustified, and deserving punishment. The attitude expressed in the answer to the last question related to the epilogue of each scenario was considered acceptable if it was in accordance with the same principles of academic, scientific and professional integrity.

3.2.3. Investigation of student attitudes toward scientific and academic integrity and intellectual property

Student attitudes toward scientific and academic integrity and intellectual property were investigated by use of a questionnaire containing six yes/no items. The questionnaire was anonymous and completed after the student passed the Medical Informatics exam. Table 6 lists the questions contained in the questionnaire on general attitudes.

Table 6. Logical questions about general attitudes of students toward scientific and academic integrity and intellectual property

Question
- Have you as a student been introduced to the principles of academic and research integrity?
- Do you consider intellectual property equal to other forms of property?
- Should the School have clearly articulated rules against plagiarism included in the official documents?
- Do you think that a researcher has to be completely honest in his/her work, irrespective of circumstances?
- In your opinion, is it acceptable to ignore research results that are not very important or in accordance with most other (expected) results?
- Is the following statement true: who cheats once, will cheat again, at least when presented with the opportunity?

The difference in distribution of positive and negative answers was tested with respect to the sex of students and the student sample, i.e., the difference in warnings against plagiarism and misconduct that students received.

3.3. Statistical analyses

The collected data were entered into two relational tables created with *MS Excel 2002* (Microsoft Corporation, SAD); one table contained data on plagiarism and the other contained data on student attitudes.

Data on sex and age of the students, scientific article chosen as the source for the essay, total number of words in the essay, absolute number of words copied from the source article, proportion of copied text, and grade obtained on their first attempt at Medical Informatics exam were entered into the table containing data on prevalence of plagiarism.

The difference in total number of words in the essay, absolute number of copied words, and proportion of plagiarized text was tested with respect to the sex of student, accessibility of the chosen source article, complexity of the topic, type of warning against plagiarism, and student achievement according to the Medical Informatics exam grade. The Kolmorogov-Smirnov test used to examine normal distribution of numerical data showed that the distributions of each of these data sets deviated from normal. Thus, differences between two groups were tested by the Mann-Whitney U test, whereas the differences among three groups were tested by the Kruskal-Wallis test. If the Kruskal-Wallis test showed a significant difference among the groups, a *post hoc* analysis was performed with the Mann-Whitney U test between all the groups, with the level of significance adjusted for multiple comparisons to determine which groups differed from each other. In the analysis of data measured on a ratio scale, $P<0.05$ was considered statistically significant, whereas in the *post hoc* analysis, the significance level was set for three groups and considered significant at $P<0.017$.

The difference in the distribution of students with respect to sex, accessibility of the chosen article, complexity of the topic, and achievement of students on the basis of the Medical Informatics exam grade in the three student samples was tested by χ^2-test. For data

measured on nominal and ordinal scales, the level of significance was increased because of the large number of students and uneven distribution. Therefore, P values obtained by χ^2-test were considered statistically significant at $P<0.01$.

Answers to questions in the 6-item questionnaire on scientific and academic integrity and intellectual property, which students completed after passing the Medical Informatics exam and data on sex and academic year in which students took the Medical Informatics course were entered into the table containing the data on student attitudes.

The difference in the distribution of answers to the question about the appropriateness of the act described in each scenario and the association with the attitude toward justifiability of and deserved punishment for such an act and with the answer to the question related to the epilogue was tested by McNemar's χ^2-test for paired data. The difference in distribution of answers to the six questions about scientific and academic integrity and intellectual property with respect to students' sex and student sample was tested by χ^2-test. For both analyses, $P<0.01$ was considered statistically significant.

Given the significant deviation from a normal distribution, all numerical data were presented as medians with range (5th-95th percentile). The frequency and distribution of categorical data was presented in contingency tables.

MedCalc, version 7.3.0.0 (MedCalc Software, Mariakerke, Belgium) and *Statistica* version 7.1 (StatSoft, Tulsa USA) were used in the statistical analysis of the data.

4. Results

4.1. Prevalence of plagiarism among medical students

The study showed that plagiarism was present among medical students. Analysis of all three student samples included in the study (N=290) revealed that only 52 (18%) of them did not directly plagiarize text from the chosen scientific article, 150 (52%) plagiarized up to 10% of the article, and 140 (48%) plagiarized over 10% of the article. The distribution of students with respect to the proportion of plagiarized text in the essays is presented in Figure 1. The median value of the proportion of plagiarized text is 7% (range, 5th-95th percentile = 0-84).

An analysis was performed to determine the difference in the length of essay – total number of words, number of words copied from the chosen source article, and proportion of plagiarized text, with respect to the sex of students, source article, and complexity of the topic, level of warning against plagiarism, and academic achievement of students.
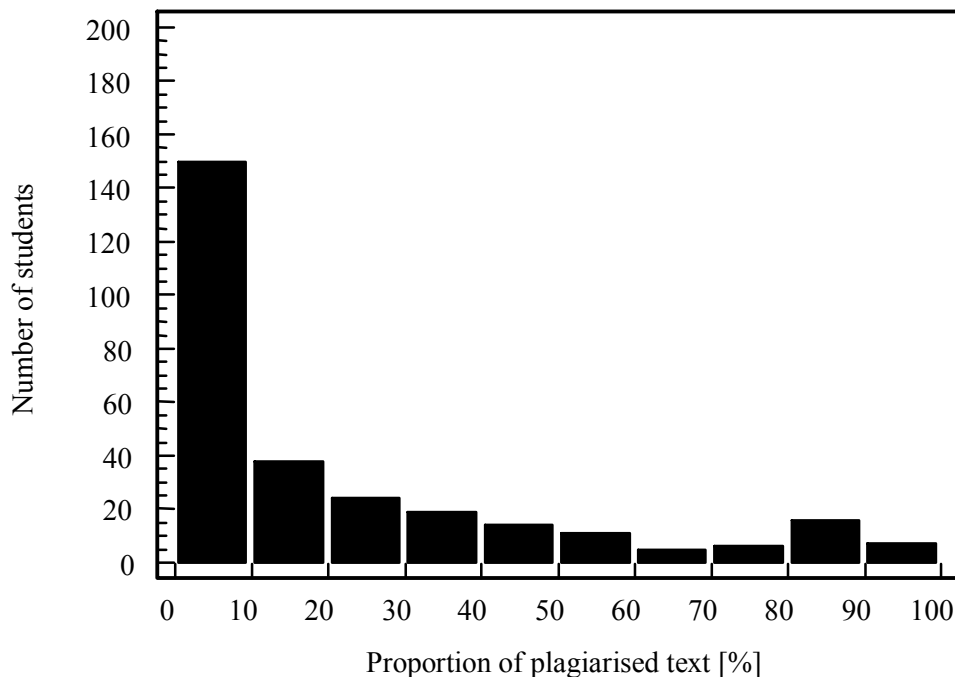

Figure 1. Distribution of students with respect to the proportion of plagiarized text (N=290).

31

Results are shown in Table 7. There was no significant difference between male and female students in the total number of words in their essays, number of words copied from the chosen article, or proportion of plagiarized text. The format of the chosen article – electronic or hard copy only – did not influence the prevalence of plagiarism, and neither did the complexity of the topic. However, the different level of warning against plagiarism had a significant effect on the prevalence of plagiarism.

In the 2001/2002 academic year, students did not receive a direct warning against plagiarism but were explicitly instructed that the essays should be their own original work. In this student sample, the average number of words copied from the source article was 74 (range, 5th-95th = 0-650), and the median proportion of plagiarized text was 17% (range, 5th-95th = 0-89). In the 2002-2003 academic year, in addition to the same essay-writing instructions, the students also received a clear explanation of what plagiarism is and were explicitly and repeatedly warned against plagiarizing the chosen source article while writing the essay. The essays written by this student sample were significantly longer than essays written by the previous sample (median value of the total number of words = 553, range 5th-95th percentile = 310-1165 vs. median = 445, range 5th-95th percentile = 280-948 words, respectively). However, there was no difference in the prevalence of plagiarism in comparison with the previous student sample (median proportion of plagiarized text =21%, range 5th-95th percentile =0-87%). A statistically significant difference in the proportion of plagiarized text ($P<0.001$, *post hoc* analysis $P<0.017$) was found in the third student sample (2004/2005 academic year). In addition to being warned against plagiarism, these students were told that their essays would be checked by plagiarism detection software and that those who plagiarized would not receive the signature of their professor as a verification of their regular class attendance. Their essays were significantly shorter than the essays of the other two student samples, contained significantly fewer copied words, and significantly lower median

proportion of plagiarized text, i.e., only 2% (range 5th-95th percentile = 0-21%) ($P<0.001$ for all comparisons, *post hoc P*<0.017).

No difference was found among the three student samples in the length of essays (total number of words), number of words copied from the source article or proportion of plagiarized text with respect to their academic achievement based on the Medical Informatics exam grade.

However, after the third student sample that received the most severe warning against plagiarism was excluded, academic achievement of students in the first two samples became a significant factor. With respect to the student academic achievement, there was no difference between poor students and average students in the length of their essays or proportion of plagiarized text. Although the median proportion of plagiarized text in the essays of excellent students was 12% (range 5th-95th percentile =0-72%), it was still significantly smaller than the median proportion of plagiarized text in essays of poor and average students (25% and 22%, respectively). The average number of copied words in the essays of excellent students was also significantly lower (56 vs. 151 and 119 words in essays of poor and average students, respectively, *P*=0.046).

When the first two student samples were analyzed as a single group, the median proportion of copied text in all essays was 19% (range 5th-95th percentile =0-88%). Only 17 (9%) students wrote essays without plagiarizing the text from the chosen scientific article, and the proportion of plagiarized text was less than 10% in 68 (34%) students. In contrast, in the 2004/2005 academic year, 0% of plagiarized text was found in 35 (38%) student essays and in 47 (51%) essays, it was less than 10%. The remaining 10 (11%) essays contained 10% or more of plagiarized text.

Table 7. Total number of words, number of copied words, and proportion of plagiarized text in student essays with respect to the investigated variables

Variable	Variable value	No. of students	Total number of words in essay			Absolute number of words copied from the chosen scientific article			Proportion of plagiarized text (%)		
		N (%)	median (5th-95th percentile)	Statistical analysis [a] Z/H	P	median (5th-95th percentile)	Statistical analysis [a] Z/H	P	median (5th-95th percentile)	Statistical analysis [a] Z/H	P
Sex	female	184 (63)	477 (272-1041)	-1.00	0.318	31 (0-614)	-0.75	0.451	8 (0-83)	-0.80	0.425
	male	106 (37)	441 (268-933)			30 (0-497)			6 (0-85)		
Scientific article	hard copy	113 (39)	504 (281-949)	1.40	0.160	60 (0-435)	1.52	0.129	14 (0-83)	1.64	0.101
	electronic	177 (61)	455 (265-956)			28 (0-492)			6 (0-83)		
Complexity of topic	simpler	206 (71)	454 (274-950)	0.45	0.656	28 (0-509)	0.03	0.973	7 (0-85)	-0.15	0.882
	more complex	84 (29)	486 (263-953)			48 (0-536)			10 (0-83)		
Direct warning against plagiarism	no	111 (38)	455 (280-948) [b]	28.57	**<0.001**	74 (0-650)	87.40	**<0.001**	17 (0-89)	84.64	**<0.001**
	yes	87 (30)	553 (310-1165) [b]			105 (0-636)			21 (0-87)		
	yes, in addition to punishment for plagiarizing	92 (32)	398 (261-846) [b]			6 (0-84) [c]			2 (0-21) [c]		
Academic achievement of students based on MI exam grade	poor	77 (27)	444 (266-912)	1.98	0.372	28 (0-669)	2.48	0.287	6 (0-83)	3.29	0.191
	average	132 (46)	456 (270-1045)			43 (0-578)			12 (0-87)		
	excellent	81 (28)	504 (275-935)			24 (0-348)			6 (0-56)		
Academic achievement of students based on MI exam grade [d]	*poor*	*49 (25)*	*444 (266-932)*	*1.17*	*0.556*	*151 (0-701)*	*6.15*	***0.046***	*25 (0-89)*	*8.43*	***0.015***
	average	*92 (46)*	*456 (270-1055)*			*119 (0-647)*			*22 (0-94)*		
	excellent	*57 (29)*	*504 (276-929)*			*56 (0-442)* [e]			*12 (0-72)* [e]		
Total		290 (100)	464 (270-951)			31 (0-498)			7 (0-84)		

[a] Mann-Whitney test was used for comparison of two groups and Kruskal-Wallis test for comparison of three groups.
[b] *Post hoc* analysis showed difference among all three student groups (*P*<0.017).
[c] *Post hoc* analysis confirmed the difference between 2004/2005 student group and the other two groups (*P*<0.017).
[d] Italics: analysis refers only to the results from the first two years of the study, i.e., 2001/2002 and 2003/2004.
[e] *Post hoc* analysis confirmed that excellent students differed from average and poor students (*P*<0.017).

Since the warning against plagiarism seemed to have the greatest influence on the difference in the proportion of plagiarized text in the student essays, i.e., differences between the 3 student samples, further analyses were performed to determine the influence of other variables that were investigated among the three student groups (Table 8).

There was no statistically significant difference among the three student samples in the distribution with respect to sex or academic achievement of students based on the Medical Informatics exam. However, the student samples significantly differed in the choice of the essay topic. In each following year of investigation, there was an increasing number of students who chose more complex topics for their essays (χ^2=15.67; *P*<0.001) and who chose essay topics from articles available in electronic format (χ^2=50.19; *P*<0.001).

Table 8. Values of investigated variables in the three student samples included in the study

Variable	Student samples (generation)			
	2001/2002 N=111	2002/2003 N=87	2004/2005 N=92	Statistical analysis
Sex (male/female)	43/68	26/61	37/55	χ^2=2.43 *P*=0.297
Chosen scientific article (hard copy/electronic format)	71/40	26/61	16/76	χ^2=50.19 **P<0.001**
Complexity of topic (simpler/more complex)	92/19	61/26	53/39	χ^2=15.67 **P<0.001**
Academic achievement (poor/good/excellent)	31/58/22	18/34/35	28/40/24	χ^2=11.15 *P*=0.025
Median (5th-95th percentile) number of words	455 (280-948)	553 (310-1165)	399 (261-846)	H=28.57 [a] **P<0.001**
Median (5th-95th percentile) number of copied words	74 (0-650)	105 (0-636)	6 (0-84) [b]	H=87.40 **P<0.001**
Median (5th-95th percentile) proportion of plagiarized text	17 (0-89)	21 (0-87)	2 (0-20) [b]	H=84.64 **P<0.001**

[a] *Post hoc* analysis confirmed the difference among all three student samples.
[b] *Post hoc* analysis confirmed the difference between 2004/2005 student group and the other two groups.

4.2.   Student attitudes toward different types of plagiarism

The results of the analysis of student attitudes toward six different cases of scientific and academic misconduct are shown in Table 9.

The first question in each of the six cases was related to the attitude toward appropriateness of the described act. The act that the lowest number of students (5%) considered to be acceptable was plagiarism without the author's consent, followed by issuing a false medical report. The latter was considered to be acceptable by 7% of students. Approximately one-fifth of students considered plagiarism by their superior (16%) and plagiarism with the author's consent (18%) to be acceptable. One-fourth of students considered cheating on exam to be appropriate, whereas self-plagiarism was considered to be appropriate by a large majority of students (65%).

According to the student attitudes toward the justifiability of the various scenarios, issuing a false medical report was found to yield the lowest number of students who felt that this behavior was justified (17%). Plagiarism by the superior and plagiarism without the author's consent were considered to be justified by a quarter of students, whereas plagiarism with author's consent (55%) and cheating on exam (57%) were considered to be justified by more than half of students. Three-quarters of students considered self-plagiarism to be justified.

The next question referred to the deserved punishment for the behavior described in the various scenarios. The proportion of students who considered that the described act required no punishment ranged from 15% for plagiarism without author's consent, to 24% for issuing a false medical report, to 25% for plagiarism by the superior, to 43% for plagiarism with author's consent. Half of the students considered cheating on exam deserved no punishment whatsoever and 79% shared the same attitude toward self-plagiarism. Students

who considered that the described act deserved punishment mostly chose a verbal warning or taking away the benefit gained by such an act as appropriate forms of punishment, whereas almost none chose exclusion from the academic or scientific community (the largest proportion was 4% of students who considered exclusion to be the right form of punishment for plagiarizing the text of the subordinate person).

When asked if they had done anything similar to the described act, the students most often gave a negative answer, "no, I did not have an opportunity" (from 32% of the students who claimed not to have been presented with the opportunity to steal and plagiarize an essay without its author's consent to 59% of the students who claimed not to have been presented with the opportunity to issue a false medical record). In all of the described cases of misconduct, except for plagiarism without author's consent (49%), a proportion of students who answered "no, I consider such a behavior unacceptable" was smaller than the proportion of students who answered "no, I did not have such an opportunity". A very small number of students admitted that they would not commit the described act out of the fear of punishment (1-9%, depending on the scenario). For all described cases of misconduct (except for issuing a false medical report), approximately 10% of the students admitted to have done something similar because they had a good reason to do it; 21% of the students who committed self-plagiarism and 6% who cheated on exam thought they did not do anything wrong.

With respect to the question of whether they would do something similar to the act described in the scenario, a small number answered "no, never" – from 6% for self-plagiarism to 40% for plagiarism by the superior. The largest number of students answered that they would do it in exceptional situations, if they had to – approximately half of students in all cases. Self-plagiarism would be committed always by 29% of the students and cheating on exam by 13% of the students. For other described acts of misconduct, the proportion of students who would do them ranged between 1% and 4%.

When asked if they had any knowledge of a real event similar to the one described in the scenario, one-third to one-half of the students reported having heard of such or similar event for all described scenarios. A similar proportion of students reported having witnessed similar cases in their immediate environment (except for plagiarism by the superior).

The last question was logical (yes/no answers) and differed for each case described. It was read to the students after the epilogue of the scenario that presented some sort of reversal of the situation. In the self-plagiarism scenario, the act was committed by a student writing an essay, whereas the epilogue to that scenario showed that the same act was committed by a scientist publishing an article. With respect to the question of whether they considered that act to be appropriate, 76% of the students answered negatively, whereas 18% gave a positive answer.

In the scenario about plagiarism with the author's consent, the person committing plagiarism was a student who got an essay from her colleague, plagiarized it, and submitted it as her own work. The epilogue to the scenario brought in a third person – a student who noticed the plagiarism and reported it to the professor. A large majority of the students (81%) considered reporting it to the professor not to be appropriate.

In the scenario about plagiarism without author's consent, a student stole her roommate's essay and submitted it as her own. In the epilogue, the roommate intends to publish the essay, but the student who stole it admits the theft and asks the roommate not to publish the essay so that her theft would not be revealed. Approximately half of the students (45%) reported they would not publish their own essay to protect their colleague for dishonest behavior.

In the case of plagiarism by the superior, a professor plagiarized his student's thesis and published it as part of his book. In the epilogue, the student – unaware of his professor's act – wants to publish the article based on his thesis but ends up accused of plagiarizing

professor's book and punished. When asked if they would publicly admit that the student was the original author of the text if they were the professor, 60% of the students gave a positive answer.

The scenario about cheating on an exam described two students switching the test during an exam. A student who did not study for the exam passed the exam due to his colleague who solved the test questions for both of them. The epilogue reveals that their act was noticed by a instructor supervising the exam. However, out of indolence or idleness, the instructor ignores the event and acts as if nothing had happened. As many as 43% of the students thought the instructor acted appropriately.

In the last scenario, a respectable physician did not physically examine a patient who was to undergo a surgery and was his good acquaintance. Nevertheless, the physician issued the medical report to spare his friend from another visit before the operation. In the epilogue, a family physician copies the medical report into the patient's medical file, explaining how important the medical findings are for the course of surgery. When asked if, in the same circumstances, they would inform their family physician that the specialist did not actually examine them, 61% of the students reported they would, whereas 29% said they would not.

Table 9. Distribution of student answers to the questions about each scenario of scientific, academic and professional misconduct

Question	Answer	No. (%) of students [a]					
		Self-plagiarism	Plagiarism with author's consent	Plagiarism without author's consent – theft	Plagiarism by the superior	Cheating on exam	Issuing a false medical report
You consider the described behavior	- appropriate - wrong	191 (65) 88 (30)	52 (18) 226 (77)	14 (5) 266 (90)	46 (16) 199 (67)	73 (25) 191 (65)	20 (7) 244 (83)
... and:	- justified - unjustified	222 (75) 46 (16)	163 (55) 93 (32)	82 (28) 190 (64)	61 (21) 173 (59)	168 (57) 89 (30)	49 (17) 203 (69)
Should the person committing the act be punished?	- no - yes, by verbal warning - yes, by being taken away the benefit gained by this act - yes, by being expelled from school	233 (79) 27 (9) 20 (7) 0 (0)	128 (43) 78 (26) 69 (23) 0 (0)	43 (15) 121 (41) 110 (37) 5 (2)	75 (25) 63 (21) 94 (32) 11 (4)	151 (51) 40 (14) 74 (25) 1 (0)	71 (24) 164 (56) 22 (7) 6 (2)
Have you ever done anything similar to the described act?	- no, I did not have an opportunity - no, I consider such an act unacceptable - no, I'm afraid of punishment - yes, I had a good reason to do it - yes, I do not think I did anything wrong	163 (55) 22 (7) 8 (3) 24 (8) 63 (21)	143 (48) 83 (28) 19 (6) 28 (9) 4 (1)	95 (32) 145 (49) 24 (8) 8 (3) 7 (2)	145 (49) 82 (28) 6 (2) 7 (2) 4 (1)	132 (45) 58 (20) 27 (9) 27 (9) 19 (6)	175 (59) 80 (27) 2 (1) 4 (1) 3 (1)
Would you ever do anything similar to the described act?	- no, never - I would, in exceptional situation if there was a real and urgent need to do so - Yes, always	17 (6) 178 (60) 85 (29)	72 (24) 195 (66) 10 (3)	109 (37) 167 (57) 4 (1)	117 (40) 116 (39) 11 (4)	59 (20) 166 (56) 39 (13)	114 (39) 143 (48) 8 (3)
Do you have any knowledge of such or similar event taking place in reality?	- I have never heard of anything similar - I have heard of such an event - I witnessed or experienced it myself; I participated in such an act.	39 (13) 104 (35) 137 (46)	50 (17) 134 (45) 94 (32)	59 (20) 131 (44) 90 (31)	136 (46) 98 (33) 11 (4)	55 (19) 98 (33) 113 (38)	85 (29) 130 (44) 50 (17)
Answer to the specific question about the described case	- no - yes	225 (76) 54 (18)	240 (81) 38 (13)	133 (45) 147 (50)	69 (23) 176 (60)	127 (43) 137 (46)	86 (29) 179 (61)

[a] Numbers in columns do not add up to the total number of students (100%) because not all the students answered all the questions.

To test the consistency of student attitudes and the association between individual answers, an analysis was performed with respect to (a) the association between the answers about appropriateness and justifiability of the described act, (b) the association between the answers about appropriateness and deserved punishment for the perpetrator, and (c) association between the answer about appropriateness of the described act and answer to the last logical question related to the epilogue. A possible change in the acceptability of attitudes with respect to the principles of scientific and academic integrity was also assessed. The results are presented in tables 10-12.

Table 10. Distribution of answers about appropriateness and justifiability of described acts of misconduct with respect to their acceptability according to the principles of scientific and academic integrity

| Behavior | Attitude toward justifiability [a] | Acceptability of student attitudes according to the principles of academic integrity N (%) | | | Statistical analysis | |
| | | Attitude toward appropriateness of the described act [b] N (%) | | | | |
		acceptable	unacceptable	total	χ^2	P
Self-plagiarism	acceptable	44 (15)	2 (1)	46 (16)	33.58	**<0.001**
	unacceptable	41 (14)	180 (61)	221 (75)		
	total [c]	85 (29)	182 (62)	**267 (91)**		
Plagiarism with author's consent	acceptable	88 (30)	5 (2)	93 (32)	102.98	**<0.001**
	unacceptable	119 (40)	44 (15)	163 (55)		
	total [c]	207 (70)	49 (17)	**256 (87)**		
Plagiarism without author's consent – theft	acceptable	187 (63)	3 (1)	190 (64)	60.66	**<0.001**
	unacceptable	71 (24)	11 (4)	82 (28)		
	total [c]	258 (87)	14 (5)	**272 (92)**		
Plagiarism by the superior	acceptable	167 (56)	6 (2)	173 (58)	8.82	**0.003**
	unacceptable	23 (8)	38 (13)	61 (21)		
	total [c]	190 (64)	44 (15)	**234 (79)**		
Cheating on exam	acceptable	85 (29)	4 (1)	89 (30)	84.79	**<0.001**
	unacceptable	98 (33)	69 (24)	167 (57)		
	total [c]	183 (62)	73 (25)	**256 (87)**		
Issuing a false medical report	acceptable	201 (68)	1 (0)	202 (68)	26.28	**<0.001**
	unacceptable	31 (11)	18 (6)	49 (17)		
	total [c]	232 (79)	19 (6)	**251 (85)**		

[a] The attitude was considered acceptable if the act was considered unjustified, and unacceptable if the act was considered justified.
[b] The attitude was considered acceptable if the act was considered wrong, and unacceptable if the act was considered appropriate.
[c] The numbers and percentages in the table add up to the number (%) of students that answered the questions rather than the total number of students (100%). All percentages were calculated with respect to the total number of students (N=295).

The data in table 10 show association between acceptable attitudes toward appropriateness and justifiability of the described act. According to the principles of scientific and academic integrity, an attitude was considered acceptable if the described act was considered wrong and unjustified. For all of the described cases, there was a statistically significant difference in the distribution of student answers. Of 85 (29%) students with the acceptable attitude toward self-plagiarism, half considered that such an act was justified, although wrong. For plagiarism with the author's consent, of 207 (70%) students who considered such an act to be wrong, 119 (40%) considered it to be justified. As many as 258 (87%) students considered plagiarism without author's consent to be wrong, but 71 (24%) of them considered it to be justified.

Plagiarism by the superior was considered to be wrong by 190 (64%) students, but justified by 23 (8%), whereas 38 (13%) students considered it both appropriate and justified.

Cheating on an exam was considered to be appropriate and justified by 69 (24%) students; of 183 (62%) students who considered it to be wrong, 98 (33%) considered it to be justified.

As many as 232 (79%) students considered issuing a false medical report to be wrong, whereas 31 (11%) students considered it to be wrong, but justified. Of 19 (6%) students with the unacceptable attitude toward the appropriateness of such an act, 18 (6%) also had the unacceptable attitude toward justifiability.

Table 11. Distribution of answers about the appropriateness of the described act and student attitudes toward deserved punishment with respect to their acceptability according to the principles of scientific and academic integrity

Conduct	Attitude toward punishment [a]	Acceptability of student attitudes according to the principles of academic integrity N (%)			Statistical analysis	
		Attitude toward appropriateness of described act [b] N (%)			χ^2	P
		acceptable	unacceptable	total		
Self-plagiarism	acceptable	45 (15)	2 (1)	47 (16)		
	unacceptable	43 (15)	189 (64)	232 (79)	35.56	**<0.001**
	total [c]	88 (30)	191 (65)	**279 (95)**		
Plagiarism with author's consent	acceptable	143 (49)	4 (1)	147 (50)		
	unacceptable	81 (27)	47 (16)	128 (43)	67.95	**<0.001**
	total [c]	224 (76)	51 (17)	**275 (93)**		
Plagiarism without author's consent	acceptable	233 (79)	3 (1)	236 (80)		
	unacceptable	32 (11)	11 (4)	43 (15)	22.40	**<0.001**
	total [c]	265 (90)	14 (5)	**279 (95)**		
Plagiarism by the superior	acceptable	165 (56)	3 (1)	168 (57)		
	unacceptable	33 (11)	42 (14)	75 (25)	23.36	**<0.001**
	total [c]	198 (67)	45 (15)	**243 (82)**		
Cheating on exam	acceptable	113 (38)	2 (1)	115 (39)		
	unacceptable	78 (27)	71 (24)	149 (51)	70.31	**<0.001**
	total [c]	191 (65)	73 (25)	**264 (90)**		
Issuing a false medical report	acceptable	192 (65)	0 (0)	192 (65)		
	unacceptable	50 (17)	20 (7)	70 (24)	48.02	**<0.001**
	total [c]	242 (82)	20 (7)	**262 (89)**		

[a] The attitude toward punishment was considered acceptable if the described act was considered to deserve punishment (irrespective of the type of punishment), and unacceptable if the described behavior was considered not to deserve punishment.
[b] The attitude toward appropriateness was considered acceptable if the described act was considered wrong, and unacceptable if the described act was considered appropriate.
[c] The numbers and percentages in columns and rows add up to the number (%) of students that answered both questions rather than the total number of students (100%). All percentages were calculated from the total number of students N=295.

Table 11 shows the distribution of acceptability of attitudes toward the appropriateness of the described act and its deserved punishment. The reader is reminded that all of the described acts were deemed to be unethical and deserving of punishment and if that attitude was stated by students it was consider as acceptable attitude. A statistically significant difference in the distribution of answers was found for all described cases.

For self-plagiarism, 189 (64%) students had the unacceptable attitude because they felt that the act was appropriate and not deserving of punishment. Of 88 (30%) students who felt

that self-plagiarism was appropriate, half responded with an unacceptable attitude toward its punishment and considered that such an act, although wrong, did not deserve the punishment.

Plagiarism with an author's consent was considered wrong by 224 (76%) students; 81 (27%) of these students did not consider this act deserved punishment.

A similar inconsistency in attitudes, where students thought that the act that was wrong but did not deserve punishment, was found for plagiarism of the superior, cheating on an exam, and issuing a false medical report. For each of these acts of misconduct except for issuing a false medical report, there were several (two to four) students who had the unacceptable attitude toward appropriateness of these acts, but nevertheless thought that they deserved punishment.

Table 12. Distribution of answers about the appropriateness of the described act and student attitudes after the epilogue with respect to their acceptability according to the principles of scientific and academic integrity

Conduct	Attitude after the epilogue	Attitude toward appropriateness of the described act [b] N (%)			Statistical analysis	
		acceptable	unacceptable	total [c]	χ^2	P
Self-plagiarism	acceptable	84 (28)	140 (48)	224 (76)	7.58	**0.006**
	unacceptable	3 (1)	51 (17)	54 (18)		
	total [c]	87 (29)	191 (65)	**278 (94)**		
Plagiarism with author's consent	acceptable	29 (10)	9 (3)	38 (13)	169.75	**<0.001**
	unacceptable	197 (66)	43 (15)	240 (81)		
	total [c]	226 (76)	52 (18)	**278 (94)**		
Plagiarism without author's consent	acceptable	141 (48)	6 (2)	147 (50)	106.29	**<0.001**
	unacceptable	125 (42)	8 (3)	133 (45)		
	total [c]	266 (90)	14 (5)	**280 (95)**		
Plagiarism by the superior	acceptable	146 (49)	30 (11)	176 (60)	5.8	0.016
	unacceptable	53 (18)	16 (5)	69 (23)		
	total [c]	199 (67)	46 (16)	**245 (83)**		
Cheating on exam	acceptable	112 (38)	15 (5)	127 (43)	16.52	**<0.001**
	unacceptable	77 (26)	58 (20)	135 (46)		
	total [c]	189 (64)	73 (25)	**262 (89)**		
Issuing a false medical report	acceptable	168 (57)	10 (3)	178 (60)	49.12	**<0.001**
	unacceptable	76 (26)	10 (3)	86 (29)		
	total [c]	244 (83)	20 (6)	**264 (89)**		

[a] The attitude was considered acceptable if the described act was considered wrong and reporting of the act was considered appropriate.
[b] The attitude toward appropriateness was considered acceptable if the described act was considered wrong, and unacceptable if the act was considered appropriate.
[c] The numbers and percentages in the table columns and rows add up to the number (%) of students that answered both questions rather than the total number of students (100%). All percentages were calculated from the total number of students N=295.

Table 12 shows the acceptability of answers about the appropriateness of the described act and acceptability of answers to the last question related to the epilogue. A statistically significant difference in distribution of acceptable and unacceptable answers was found for all cases except for plagiarism by the superior, where students' attitudes before and after the epilogue were consistent.

For self-plagiarism, 140 (48%) students felt that self-plagiarism was appropriate when it was done by a student, but considered it unacceptable when it was done by a scientist. Only 84 (28%) students thought self-plagiarism was unacceptable in both cases.

For plagiarism with author's consent scenario, 226 (76%) students had the acceptable attitude toward the appropriateness of such act, but 197 (66%) of them thought it was wrong to report such an act, which was considered as unacceptable attitude.

Although the largest number of students, 266 (90%) of them, considered that plagiarism without author's consent was wrong, 125 (42%) of them would protect the person committing such plagiarism even to their own detriment – they would rather not publish their essay than let the person committing plagiarism be caught.

For the plagiarism by the superior scenario and its epilogue, the students were asked to put themselves in the position of the professor, the authority, in the case where a student was the damaged party. There was no statistically significant difference in the distribution of acceptable and unacceptable answers to the question about the appropriateness of this act and admission of misconduct.

For cheating on an exam, the difference in distribution of answers was statistically significant ($P<0.001$). Of 189 (64%) students who thought this act to be inappropriate, 77 (26%) considered that the instructor made the right decision by ignoring the misconduct he noticed. However, of 73 (25%) students who considered cheating on an exam to be appropriate, which is an unacceptable attitude, 15 (5%) thought that the instructor's conduct was wrong.

Issuing a false medical report was considered wrong by 244 (83%) students. However, 76 (26%) of them would not report it to their family physician although it directly concerned their health. Of 20 (6%) students who felt that the described act was acceptable, half would

nevertheless inform their family physician that the specialist in internal medicine did not examine them.

4.3. General attitudes of students toward scientific and academic integrity and intellectual property

The general attitudes of students toward scientific and academic integrity unrelated to any real or fictitious events and acts were examined by use of the 6-item questionnaire. The results are shown in Table 13. When asked, 167 (57%) students reported they knew the principles of scientific integrity. Most students (201, or 68%) considered intellectual property equal to any other form of property. In addition, the need for a university school to have clearly articulated rules against plagiarism included in the official documents was supported by 199 (67%) students, whereas 57 (19%) did not consider it necessary. Two hundred and twenty four students (76%) believed that a scientist has to be completely honest in his or her work, however, 23 (8%) thought that this was not the case. Many students, 191 (65%) of them, considered that it is impermissible to ignore individual results that do not correspond with most other (expected) results; however 61 (21%) considered it permissible.

The statement "once a cheater, always a cheater, or at least whenever there's an opportunity" was considered true by 107 (36%) students, whereas half of them thought it was not true.

There was no significant difference in the general attitudes toward scientific and academic integrity and intellectual property between men and women or among the three student samples included in the study according to the distribution of their answers.

Table 13. Answers to questions about research and academic integrity and intellectual property and distribution of answers with respect to sex and student sample

Question	Answer	No. (%) of students [a]				No (%) of students [a]			
		total (N=295)	men (N=108)	women (N=187)	Statistical analysis	Generation 2001/2002 (N=114)	Generation 2002/2003 (N=88)	Generation 2004/2005 (N=93)	Statistical analysis
Were you as a student introduced to the principles of research and academic integrity	Yes	167 (57)	59 (55)	104 (56)	χ^2=0.09	75 (66)	42 (48)	50 (54)	χ^2=4.25
	No	87 (29)	28 (26)	56 (30)	P=0.760	28 (25)	30 (34)	29 (31)	P=0.119
Do you consider intellectual property equal to other forms or property?	Yes	201 (68)	74 (69)	122 (65)	χ^2=2.66	83 (73)	53 (60)	65 (70)	χ^2=2.28
	No	55 (19)	13 (12)	40 (21)	P=0.103	21 (18)	20 (23)	14 (15)	P=0.320
Should a school have clearly articulated rules against plagiarism included in the official documents?	Yes	199 (67)	68 (63)	125 (67)	χ^2<0.01	83 (73)	59 (67)	57 (61)	χ^2=2.08
	No	57 (19)	19 (18)	37 (20)	P=0.983	21 (18)	14 (16)	22 (24)	P=0.353
Do you think that a scientist has to be completely honest in her or his work irrespective of the circumstances?	Yes	224 (76)	75 (69)	144 (77)	χ^2<0.01	93 (82)	66 (75)	65 (70)	χ^2=2.54
	No	23 (8)	8 (7)	14 (7)	P=0.971	9 (8)	4 (5)	10 (11)	P=0.281
Do you think that it is permissible in research to ignore individual results that are not very important and do not correspond to the most (expected) results?	Yes	61 (21)	16 (15)	44 (24)	χ^2=2.02	27 (24)	14 (16)	20 (22)	χ^2=1.42
	No	191 (65)	70 (65)	115 (61)	P=0.156	75 (66)	59 (67)	57 (61)	P=0.491
Is the following statement true: Once a cheater, always a cheater, or at least when there is an opportunity?	Yes	107 (36)	33 (31)	70 (37)	χ^2=0.63	46 (40)	31 (35)	30 (32)	χ^2=0.59
	No	146 (49)	54 (50)	89 (48)	P=0.429	57 (50)	42 (48)	47 (51)	P=0.745

[a] Numbers in columns do not add up to the total number of students (100%) because not all students answered all the questions.

5. Discussion

The results on the prevalence of plagiarism and student attitudes toward academic and scientific integrity are disturbing. The finding that only 18% of students did not plagiarize their essays confirms the suspicion that most students plagiarize the sources that should serve them only as a material for critical review, as the beginning of their own study that will result in an original student essay.

There are a few available reports of studies that have measured the proportion of students who have committed plagiarism. These studies were mostly based on data collected by anonymous questionnaires. In their study on plagiarism among students, Braumoeller and Gaines used a software program for plagiarism detection and found that 12% of student essays could have been plagiarized (65). Unfortunately, there is no official determination of the specific percentage of the copied text in a document that would be considered plagiarism. Some of the software for text analysis available on the internet that compare a chosen document with the documents available online use a scale based on the proportion of copied text divided into four to five equal sections ranging between 0% and 100% (45). The proportion of copied text in the analyzed document may range from low to high and there is no limit value above which the document may be considered an instance of plagiarism. In Braumoeller and Gaines's opinion, every paper that contains more than one-eighth (12.5%) of copied text should be considered a case of plagiarism. In our study, almost half (48%, Figure 1) of the students submitted essays containing more than 10% of copied text. Consequently, if we are to adopt Braumoeller and Gaines' definition, a large number of student essays could be considered as having been plagiarized from another source.

Interestingly, the proportion of plagiarized text in student essays was not influenced by the availability of the source or complexity of the essay topic. Several authors indicated that

the increasing trend in plagiarism among students is the result of a wide availability of electronic sources and text editing programs with a simple "copy/paste" command (35,49,68). Therefore, it is logical to assume that students would copy more from the sources that are available in electronic format. However, this assumption was not confirmed by the present study. On the other hand, according to Kellog (39), the development of information technology and the internet does not significantly increase the prevalence of plagiarism among students, but rather they increase the possibility of detecting plagiarism (36,43).

The complexity of the topic did not influence the proportion of the copied text in student essays either. However, electronically available sources dealing with more complex topics were chosen more often by each subsequent sample of students in the present study. Development of computers and their increasing availability and use among students (80) have resulted in an increased use of electronically available material for educational purposes. Due to the fast development and acceptance of topics related to medical informatics during the course of the present study, the difference in the complexity of topics diminished and the last student sample included in this study (2004/2005) chose more complex topics more often in comparison with the student sample from 2000/2001 (Table 8). A possible reason for the lack of difference in the proportion of plagiarized text in student essays with respect to the availability (electronic or hard copy) of source articles could be that the students of Rijeka University School of Medicine used computers for learning purposes to a lesser extent (81).

Although some previous research found a difference in attitudes toward plagiarism and scientific integrity between men and women (55), the present study did not find any difference between male and female medical students in the prevalence of plagiarism.
The only factor that deterred students from plagiarizing was the warning that essays would be checked by software for plagiarism detection and that students caught plagiarizing would be punished, whereas verbal warnings against plagiarism and its detrimental effects had no effect

on the proportion of plagiarized text. The students who were not directly warned against plagiarism had 17% of their essays' text copied verbatim from the source article. The students who were directly warned against plagiarism had about 21%, whereas the students who were warned that their essays would be checked by plagiarism detection software and that those who plagiarized would be punished had only 2% of plagiarized text in their essays ($P<0.001$). The fact that warning against plagiarism, irrespective of its severity, does not lead to the decrease in plagiarizing among students was confirmed by Braumoeller and Gaines's study (65). Using plagiarism detection software, the two authors found that 12% of students plagiarized their essays. However, in the present study the warning that essays would be checked for plagiarism and that students caught plagiarizing would be given a lower final grade had a significant effect. After this warning, only one of 90 students submitted the essay that was probably plagiarized. Also, the proportion of the text in essays that was copied verbatim from the source article was significantly reduced (from the average 20% to 2%; Table 7). But, even in this group of students, there were 11% of students who copied verbatim more than 10% of the source article irrespective of the consequences. The results clearly indicate that students will plagiarize regardless of the warning if there is a possibility that they will not be caught, and some of students will plagiarize even if there is a high probability that they will be caught. Nevertheless, a warning that an objective and efficient method for plagiarism detection and consequent punishment would be used deterred most students from committing plagiarism.

The use of software for plagiarism detection is a normal practice at many universities, especially in the USA, where the educational system and evaluation of acquired knowledge often include writing essays and other reports (12,13,43,45,71).

The academic achievement of students determined on the basis of their success at the Medical Informatics exam did not have any influence on the proportion of the copied text in

student essays. From the results presented in Table 7, it is obvious that there is no difference between excellent, average, and poor students in the proportion of copied text in their essays (6% vs. 12% vs. 6%, respectively; P=0.191). However, if the third student sample (2004/2005), who copied significantly less than the previous two, is excluded from the analysis, the academic achievement of students suddenly becomes a significant and independent factor. The students who got an A or B in the Medical Informatics exam in their first attempt (the group of excellent students) had 12% of the essays text copied from the source article on average, which is significantly less than the students who got a C or D (the group of average students, 22%) and students who failed the exam or did not even take it for a year after the completion of the Medical Informatics course (the group of poor students, 25% of copied text) (P=0.015). Thus, according to the results of this study, if students are unaware of the real possibility to be caught and punished, the only factor influencing the proportion of copied text in their essays is their level of academic achievement. This finding shows that student academic achievement is not only manifested in their knowledge and grades but it is also associated with in their sense of academic integrity.

An interesting result is that the length of essays differed between the three student samples included in this study. All students knew that the essay was mandatory but not graded and its quality did not influence the final grade in Medical Informatics. The difference in the total number of words (455 vs. 553 vs. 398 in the three academic years; P<0.001, Table 8) between the three student samples could have resulted from a more serious approach to essay writing among students of the second sample in comparison with the first student sample included in this study. However, it did not prevent them from plagiarizing the source article to the same extent as the first sample, irrespective of the length of essay. The third student sample included in the study wrote significantly shorter essays as they knew that they would

be controlled for plagiarism and punished accordingly, which implies that they wrote the essays only to formally complete the task and fulfill the obligation.

Among the limitations of the present study are those related to the capabilities of the software for plagiarism detection. WCopyfind does not search the Internet for documents that might have been used as other sources for plagiarism. It only compares documents with one another specified by the user (47). Given that the students were not discouraged to use additional literature, it is possible that they copied text from other sources that remain unknown. Furthermore, the software did not recognize the content of the figures and tables that could also have been plagiarized, so the real proportion of the plagiarized text may have been higher than the proportion obtained in this study.

The analysis of student attitudes toward academic, scientific and professional misconduct produced disturbing results. Many students considered self-plagiarism to be an appropriate (65%) and justified practice (75%). Although self-plagiarism is an act that scientists often disagree about (25,20,21,82), it is undisputable that it is a dishonest and detrimental act and should be treated equally as plagiarism. In comparison with attitudes of students in the USA, of whom 37% considered self-plagiarism to be appropriate (83), 68% of students in Croatia also considered the practice to be acceptable.

We can assume that students in Croatia are not familiar with the fact that self-plagiarism is wrong; however, almost half of the students (48%) who consider self-plagiarism in case of essay writing to be appropriate consider the same act to be inappropriate if it is committed by a scientist (Table 12). The change in the attitude caused by the change in the context shows that students are aware that such an act is wrong, but still consider it right and justified in the academic, i.e., student, context. In this respect, it should be noted that the first doctoral dissertation ever to be revoked in Croatia was revoked because of self-plagiarism. It was a copy of the applicant's master's thesis (data available from the archive of Rijeka

University School of Medicine). The split in public opinion on this case, even the difference in attitudes within the Croatian academic community, indicated that the public needed to learn more about the true nature of plagiarism, that it is detrimental and unproductive behavior that brings undeserved benefit to the perpetrator just as any other breach of the principles of academic integrity. Another case that attracted public interest was the revocation of master's degree at the Split University School of Law, because the master's thesis was a plagiarism of the book written and published by the applicant's mentor. Again, the public was divided on this issue, but the plagiarism was undisputable and the perpetrator punished. This case revealed that some positive steps have been taken toward better detection and appropriate punishment for such misconduct in our academic community.

Of all 6 misconduct scenarios presented, plagiarism without the author's consent, i.e., was considered to be appropriate by the lowest number of students (5%) and 18% considered plagiarism with the author's consent to be appropriate. Copying the essay from another student (consent not specified) was also considered appropriate by 6% of students in the USA (83) and 27% of students in the United Arab Emirates (55). However, in Croatia, 57% of students would copy a colleague's essay without asking for permission and 66% of them would do it with colleague's consent, if the situation required it. This finding indicates that students think there is a need for such behavior and that they would commit the act regardless of the fact that they know it is wrong. It is even more difficult to understand and explain the results of the analysis of attitudes toward justifiability of such acts, where plagiarism with and without author's consent was considered justified by 55% and 28% of the students, respectively.

Although a small percentage of the students admitted to having already done similar acts (3-9% for acts described in all six cases), it is troubling to find that they would commit

them nevertheless. Almost half (45%) of the students heard of such events taking place in their environment and a third (32%) witnessed such or similar acts (Table 9).

Cheating on exams is another type of accepted behavior among students. A quarter of students (25%) considered this behavior to be appropriate and over half (57%) considered it to be justified. About the same percentage of students reported that they would cheat on an exam it there was a need. Especially alarming was the finding that 13% of students would always cheat on exams. This is a huge percentage in comparison to the USA, where only 2% of students considered cheating on an exam to be an appropriate behavior and as many would do it. In a similar study conducted in the United Arab Emirates, 2% of students considered cheating on an exam to be appropriate, 8% would do it, and 19% were undecided. An interesting and disappointing finding of the present study is that about half of the students (46%) considered the behavior of the instructor who chose to ignore two students cheating on an exam to be appropriate. This indicates that many students approve of unjust and unethical behavior of the instructor, which is a particularly dismaying result.

The problem of cheating on exams in an academic setting was seriously discussed in the Croatian media in early 2006, when the list of names of students of the University School of Electrical Engineering and Computing who cheated on an exam was posted on the website and bulletin boards of the school. The discussion in the media focused on the question of violation of students' privacy by public announcement of their names rather than the dishonest nature of their behavior, which again indicated that academic and scientific integrity needed better public promotion if infringements of the basic principles of academic honesty were to be unanimously condemned.

Issuing a false medical report was considered wrong by most students (83%), even more so than in the USA (75%) and the United Arab Emirates (78%). However, a troubling finding is that in certain circumstances, 48% of the students in our study would issue a false

medical report, which is again a higher percentage than that found in the USA (32%) and in the United Arab Emirates (13%).

In the case where the professor writing a chapter for his book copies from his student's thesis without acknowledging the student as the author, most students (67%) had the appropriate attitude toward appropriateness of this act. However, their attitudes toward the justifiability and deserved punishment for this act were not consistent (Table 10 and 11). The students were consistent only in their attitude toward admission of plagiarism. If they were the professor, 60% of students would admit to plagiarism if the student trying to publish the article based on his diploma thesis would be publicly accused of plagiarizing the professor's book. This finding could be the result of students' identification with the student unjustly accused of plagiarism, which was probably easier than any identification with the professor. Nevertheless, a professor should be considered a moral authority and students, in the process of identification with authority, need him to be honest and just.

Especially interesting were students' attitudes toward the deserved punishment for the misconduct described in the six scenarios. With respect to individual acts of misconduct, a large proportion of students had the attitude that the perpetrator did not deserve any punishment. Furthermore, 79% of the students reported that self-plagiarism should not be punished, 43% reported that plagiarism with the author's consent should not be punished, and 15% reported that plagiarism without author's consent should also not be punished. A quarter of students thought that issuing a false medical report did not deserve punishment, and half of the students thought that cheating on exams should not be punished. Most students who thought that the acts of misconduct described in the six cases should be punished opted for a verbal warning or for the denying of the benefits gained from misconduct as an appropriate form of punishment (Table 9). However, almost none of the students chose expulsion from school as the appropriate punishment. In a study performed among the students and faculty at

the College of Dentistry in Saskatchewan, Canada, which investigated their attitudes toward punishment for different offenses, none of the study subjects, whether students or faculty, thought that cheating on exams should not deserve punishment or that it should only deserve a verbal warning (75). The largest number of students (49%) thought that students who cheated on exams should repeat the exam (in contrast to 25% of students in our study) and 12% thought they should be expelled from school (0% in our study). In the study conducted in the United Arab Emirates, 8% of students would not punish other students for cheating on exams, and 26% would suspend them from school or make them repeat the study year (55). In many universities, especially in the USA, penalties for plagiarism and cheating on exams are very rigorous by comparison and include suspension from school for an indefinite period of time or outright expulsion (46,73,76,78).

When asked if they themselves had ever committed the described acts of misconduct, the proportion of students who answered negatively to that question, stating fear of punishment as the reason, was rather small (1-9% depending on the described act, Table 9). However, if we look at the prevalence of plagiarism, most students were deterred from committing plagiarism by the warning that their essays would be computer-checked for plagiarism and the perpetrators punished. A small number of students admitted to having committed the described acts of misconduct because they had good reasons for them or did not think they were doing anything wrong, whereas the largest number of students reported they had no opportunity to commit the described acts of misconduct. With respect to their attitudes toward appropriateness, justifiability, and readiness to commit academically dishonest acts, it is reasonable to conclude that the students gave socially desirable answers and that most of them would commit misconduct unless there were measures of control and punishment for such a behavior. The results of the studies into morality, Machiavellian behavior, and socially desirable responses of medical students in Croatia support this

conclusion (79). Hren and colleagues (79) found that a large proportion of students had pronounced Machiavellian characteristics (40% of the students in the upper part of the scale as opposed to 15% of the students in the USA). Machiavellianism describes people of manipulative behavior motivated exclusively by their own interests, who often provide socially acceptable answers to present themselves in better light (79).

In academic and scientific contexts, the question of reporting unethical behavior to the faculty is especially sensitive. Whistleblowers are often condemned by their environment (55,84) and the majority of students in the present study had similar attitudes toward such individuals. The epilogue to the case of plagiarism with the author's consent described a student reporting of the misconduct to the professor, and over 80% of the students considered such an act to be morally wrong. Also, 29% would not tell their family physician that they were issued a false medical report by the specialist in internal medicine even though such an act could have important implications for their own health. In the case of plagiarism without an author's consent, 45% of the students would not publish their own work in order to protect the stealer. In a similar study investigating the readiness of students in the United Arab Emirates to report a serious academic misconduct, 33% of students would not report it (55). In another study conducted at the University of Dundee Medical School in Scotland, 40% of students considered that the perpetrator should be reported and 13% would actually report such a person (84). In Croatia, 44% of students would never report the misconduct if they noticed it, whereas only 2.6% would always report it (31).

The reluctance of reporting academic misconduct is mostly a culturally conditioned phenomenon, as is the prevalence of academic misconduct itself (31,53,79). The results of the present study are in accordance with previous findings, which show that a large proportion of students in Croatia resort to cheating and other forms of academic misconduct significantly more often than their colleagues in western countries (31). Significant factors predicting the

occurrence of misconduct are attitude toward cheating, behavior of the group a student belongs to, and academic level, as students in their upper years of studies tend to cheat more and more often than younger students (31). A study of student attitudes toward plagiarism and reporting plagiarism in Russia, USA, the Netherlands, and Israel indicated that the tolerance toward plagiarism and intolerance toward whistleblowers were more pronounced in post-communist countries (53). The cultural environment of post-communist countries with high rate of corruption, Croatia included (according to the Transparency International data, corruption perception index for Croatia in 2005 was 3.4, ranking Croatia in 71st place among 159 countries) is characterized by high tolerance toward cheating, which creates inappropriate attitudes toward academic and scientific integrity (31). One of the characteristics of an authoritarian regime is the transfer of superego onto authority. In such a case there is no individual responsibility. Therefore, individuals tend to be allowed to do anything that society tolerates. Maturity, independence and responsibility are not encouraged in such regime. Instead, it tend to nurture a primitive superego by which individuals do not commit wrong acts only because of fear of harsh punishment from the repressive authorities.

The fact that students do not have a clear understanding of whether an act is morally right or wrong and that they must be taught rules of academic and scientific integrity is obvious from the inconsistency in their attitudes toward appropriateness and justifiability of the described acts, the deserved punishment, and the epilogues to the scenarios in which the situation reversed or the same act was committed in more serious circumstances (Tables 10-12). The distribution of appropriate and inappropriate attitudes according to the principles of academic integrity significantly differed in all cases except in the case of plagiarism by the superior, where the students remained consistent in their attitudes toward appropriateness and possible admission of this act in the circumstances described.

The phenomenon of socially desirable answers is shown in the last part of the present study in which 55% of the students reported to have been introduced to the principles of academic and scientific integrity and over 60% considered intellectual property to be equal to other forms of property. The students thought that the school should have clearly formulated rules against plagiarism included in their official documents (while at the same time, 57% of them considered cheating on exams justified), that a scientist must be absolutely honest in his or her work irrespective of the circumstances (although over half of students would commit almost all the acts of misconduct described in the scenarios if they needed to), and that in research it was unacceptable to ignore individual results that deviated from the expected. The sentence, "once a cheater, always a cheater, or at least when there is an opportunity" was not considered true by 50% of the students.

However, inappropriate behavior observed in the research context was shown to be a good predictor of such a behavior in later professional work (29,85). It can be expected that dishonest students will develop into dishonest physicians who lack the necessary medical knowledge (30-32). Therefore, medical schools and other academic institutions have a moral obligation to teach students about academic and professional integrity. In spite of the fact that Croatian universities have clearly formulated guidelines for avoiding plagiarism and that there is the possibility of consequent expulsion from the university for students who breach the ethical code (66), it is clear according to the results of the present study that these measures are not nearly enough. Students should be taught about all types of academic, research and professional integrity so that they do not commit unethical acts out of ignorance or due to indifference or leniency of academic environment. Conditions have to be created so that students can adopt fundamental academic principles of honesty and integrity and integrate these principles as their own attitudes. In that process, identification with professors as role models is very important because there is high probability that students will model their

professors' attitudes towards science, academic and professional integrity. Honest and responsible faculty are necessary and are crucial for the development of honest students and responsible future scientists.

Another limitation of the present study in student attitudes stems from the fact that students had to complete quite a large number of questionnaires – seven in total. Since some of the students did not attend all practicum classes in Medical Informatics and some of them did not complete all the questionnaires or answered all the questions, the missing data could have influenced the distribution of the answers to particular questions. However, due to a large number of students included in the study, the possible bias in this case can be considered negligible. The last questionnaire on scientific and academic integrity and intellectual property was completed only by students who passed the exam, which is the reason why part of the data – answers of the students who did not pass the exam – were missing at the time of the completion of the study.

Software available today can be used not only to control student essays but also for the purpose of education of students and promotion of high academic standards and moral values. Universities in other countries use electronic education systems to explain to students what is considered unethical and prohibited behavior in academic and scientific settings (58). It is obvious that computer and information technology have made cheating easier. There are student papers, master's theses, or even doctoral dissertations available for online purchase and not only in English. There are websites in Croatian language offering crib notes, homework papers, essays on required readings, and tests used in some universities and high schools. On the other hand, the web and information technology can be used to control student papers for plagiarism or to deter students from plagiarizing, as indicated by the results of the present study. Today, "philanthropists" selling tests, essays, and answers to test questions freely post their announcements on bulletin boards in university schools. Such

practice must be stopped and severely punished if cheating and plagiarism are to be eradicated we need to encourage creativity and real acquisition of knowledge in universities and schools, to educate and raise competent and honest experts and scientists rather than technicians who will continue to work only on development of cheating methods (46,86). The academic and scientific communities should promote the highest moral values and be above the narrow-minded culture typical of a small community, be honest and universal. This can be done only if our community invests efforts into its own education and the education of its students.

6. Conclusions

1. Plagiarism, appropriation of another's intellectual property, is present among medical students, and was shown on students' essays that were based on a scientific article that was used as a source. The proportion of plagiarized text in student essays was not influenced by the availability of the source (electronic format available from the School's website or hard copy of the article published in conference proceedings) or by the complexity of the essay topic.

2. Significant reduction in the prevalence of plagiarism was achieved only after a clear warning that the essays would be checked by use of software for plagiarism detection (an objective method) and that students caught plagiarizing would be punished. Teaching students the meaning of the word "plagiarism" and the detrimental effects it may cause and giving them an explicit verbal warning against plagiarism does not reduce its prevalence.

3. Student attitudes toward academic misconduct are worrisome and indicate the need for teaching and promotion of the principles of academic integrity among students. A large proportion of students consider dishonest behavior to be right and justified, not deserving punishment or deserving only a symbolic punishment. Students reported that they commit dishonest acts if they needed to, although most of them denied having already committed acts that breach academic honesty. Inconsistency in student attitudes toward academic integrity indicates a lack of knowledge and the recognition that certain behaviors are unethical.

4. When asked about general attitudes toward academic and scientific integrity, the students appear to have provided some socially desirable answers, although these answers were contrary to their behavior.

5. Differences in the prevalence of plagiarism and attitudes toward plagiarism between male and female students were not found. The academic achievement of students was the factor that influenced the proportion of plagiarized text in student essays only if they were not warned about the subsequent computer-check of their work and punishment for plagiarism. If students are warned that their essays will be subjected to detection technology and that they will receive stiff punishment, they will tend not plagiarize or be dishonest.

6. Faculty staff should be aware of the inappropriate attitudes of students toward academic misconduct. They should educate students and promote the highest standards of academic integrity. For education to be efficient, schools should have clearly formulated rules against plagiarism and should implement these rules as well as punishment for breaching them in order to increase the quality of studying and excellence of the future experts and scientists.

7. References

1   Cohen JJ. Foreword. IN: Hudson Jones A, McLellan F, ur. Ethical issues in biomedical publication. Baltimore and London: The Johns Hopkins University Press; 2000. p. vii-ix.

2   Marušić M. Science. In: Marušić M, editor. Introduction to scientific work in medicine [in Croatian]. Zagreb: Medicinska naklada; 2004. p. 1-9.

3   Editorial Policy Committee, Council of Biology Editors. Ethics and policy in scientific publication. Bethesda, Maryland: Council of biology editors, inc; 1990.

4   Giles J. Scientists behaving badly. Available from URL: http://www.bioedonline.org/news/news-print.cfm?art=837. Accessed: May 29, 2006.

5   Martinson BC, Anderson MS, de Vries R. Scientist behaving badly. Nature. 2005;435:737-8.

6   Marušić M, Katavić V, Hren D. Scientific integrity. In: Marušić M, editor. Introduction to scientific work in medicine [in Croatian]. Zagreb: Medicinska naklada; 2004. p. 191-200.

7   Office of Research Integrity. ORI policy on plagiarism. ORI newsletter. 1994;3(1). Available from URL: http://ori.dhhs.gov/policies/plagiarism.shtml. Accessed: May 29, 2006.

8   Office of Research Integrity. About ORI – history. Available from URL: http://ori.dhhs.gov/about/history.shtml. Accessed: May 29, 2006.

9   Office of Research Integrity. About ORI – Functional Overviews. Available from URL: http://ori.dhhs.gov/about/dio.shtml. Accessed: May 29, 2006.

10   Price AR. Cases of plagiarism handled by the United States Office of Research Integrity 1992-2005. Plagiary: Cross-Disciplinary Studies in Plagiarism, Fabrication, and Falsification. 2006;1(1):1-11.

11   Mojon-Azzi SM, Mojon DS. Scientific misconduct: from salami slicing to data fabrication. Ophthalmic Res. 2004;36(1):1-3.

12   Austin MJ, Brown LD. Internet plagiarism: developing strategies to curb student academic dishonesty. The Internet and Higher Education. 1999;2:21-33.

13   Schiller RM. E-Cheating: Electronic Plagiarism. Journal of the American Dietetic Association. 2005;105(7):1058.

14   Das SK. Plagiarism in higher education: is there a remedy? Scientist. 2003;17:8.

15   Gilbert FJ, Denison AR. Research misconduct. Clin Radiol. 2003;58(7):499-504.

16   Parrish DM. When ethics fails: Legal and administrative causes of action and remedies. IN: Hudson Jones A, McLellan F, ur. Ethical issues in biomedical publication. Baltimore and London: The Johns Hopkins University Press; 2000. p. 197-222.

17   Institute of Medicine Committee on Assessing Integrity in Research Environments. Integrity in scientific research: creating an environment that promotes responsible conduct. Washington (DC): The National Academies Press; 2002. p. 167-77.

18   Clouthier SG. Institutionalized plagiarism. Scientist. 2004;18(15):8.

19   Hansen TW. Neonatal jaundice and scientific fraud in 1804. Acta Paediatr. 2002;91:1135-8.

20   Roig M. Re-using text from one's own previously published papers: an exploratory study of potential self-plagiarism. Psychol Rep. 2005;97(1):43-9.

21   Roig M. The subtler forms of self-plagiarism: when is same-authored text reuse appropriate? In: Conference on Plagiarism across the Science Disciplines: An Exploration of the Parameters of Plagiarism in Scholarly and Scientific Publications, New York University Medical Center, New York, USA, 2005.

22   Kantha SS. Nobel Prize Winners for Literature as Palliative for Scientific English. Croat Med J. 2003;44(1):20-3.

23   Corson SL, Decherney AH. Duplicate editorial on duplicate publication. Fertil Steril. 2005;83(4):855-6.

24   Giles J. Special report - taking on the cheats. Nature. 2005;435:258-9.

25   Broome ME. Self-plagiarism: Oxymoron, fair use, or scientific misconduct? Nurs Outlook. 2004;52:273-4.

26   Petrovečki M, Scheetz MD. Croatian Medical Journal introduces culture, control, and the study of research integrity. Croat Med J. 2001;42:7-13.

27   Katavić V. Five-year Report of Croatian Medical Journal's research integrity editor – policy, policing, or policing policy. Croat Med J. 2006;47:220-7.

28   Marušić A. Author misconduct: editors as educators of research integrity. Med Educ. 2005;39(1):7-11.

29   Harding TS, Carpenter DD, Finelli CJ, Passow HJ. Does academic dishonesty relate to unethical behavior in professional practice? An exploratory study. Science and Engineering Ethics. 2004;10:311-24.

30   Kenny D. Student plagiarism and professional practice. Nurse Educ Today. 2006;Apr 16. In press.

31   Hrabak M, Vujaklija A, Vodopivec I, Hren D, Marušić M, Marušić A. Academic misconduct among medical students in a post-communist country. Med Educ. 2004;38:276-85.

32   Rozance CP. Cheating in medical schools: implications for students and patients. JAMA. 1991;266:2453-6.

33   Glick SM. Cheating at medical school. BMJ. 2001;322:250-1.

34   Baldwin DC, Daugherty SR, Rowley BD, Schwarz MD. Cheating in medical school: a survey of second year students at 31 schools. Acad Med. 1996;71:267-73.

35   DeVoss D, Rosati AC. "It wasn't me, was it?" Plagiarism and the web. Computers and composition. 2002;19:191-203.

36   Eysenbach, G. Report of a case of cyberplagiarism - and reflections on detecting and preventing misconduct using the Internet. J Med Internet Res. 2000;2(1):e4.

37   McLellan F. Ethics in Cyberspace: The challenges of electronic scientific publishing. In: Hudson Jones A, McLellan F, ur. Ethical issues in biomedical publication. Baltimore and London: The Johns Hopkins University Press; 2000. p. 166-93.

38   Lyon C, Barrett R, Malcolm J. Plagiarism is easy, but also easy to detect. Plagiary: Cross-Disciplinary Studies in Plagiarism, Fabrication, and Falsification. 2006;1(5):1-10.

39   Kellogg AP. Students plagiarize less than many think, a new study finds. The chronicle of higher education, Information technology. Available from URL: http://www.chronicle.com/free/2002/02/2002020101t.htm. Accessed: May 29, 2006.

40   Baruchson-Arbib S, Yaari E. Printed versus internet plagiarism: a study of students' perception. International Journal of Information Ethics. 2004;1. Available from: URL: http://container.zkm.de/ijie/ijie/no001/ijie_001_05_baruchson.pdf. Accessed: May 29, 2006.

41   Burnard P. All your own work? Essays and the Internet. Nurse Educ Today. 2002;22(3):187-8.

42   Chase K. Teachers fight against internet plagiarism. Available from URL: http://www.csmonitor.com/2004/0302/p12s01-legn.html. Accessed: May 29, 2006.

43   Barrie JM, Presti DE. Digital plagiarism--the Web giveth and the Web shall taketh. J Med Internet Res. 2000;2(1):e6.

44   McCullough M, Holmberg M. Using the Google search engine to detect word-for-word plagiarism in master's theses: a preliminary study. Coll Stud J. 2005;39(3):435-41.

45   http://www.turnitin.com/static/home.html. Accessed: May 29, 2006.

46   Bloomfield L. The importance of writing. Available from URL: http://www.plagiarism.phys.virginia.edu/essays/The%20Importance%20of%20Writing.html. Accessed: May 29, 2006.

47   Bloomfield L. Wcopyfind 2.2 instructions. Available from URL: http://plagiarism.phys.virginia.edu/WCopyfind%202.2.html. Accessed: May 29, 2006.

48   Martin B. Plagiarism: policy against cheating or policy for learning? Nexus. 2004;16(2):15-6.

49   Grover D. Plagiarism and the internet: the use of correlation techniques to detect plagiarism. Computer Law and Security Report. 2003;19:36-8.

50   Callahan D. On campus: Author discusses the "Cheating culture" with college students. Plagiary: Cross-Disciplinary Studies in Plagiarism, Fabrication, and Falsification. 2006;1(4):1-8.

51   Hayes N, Introna L, Whitley EA. Plagiarism, values and computing: differing cultural expectations of academic work in information systems education. Available from URL: http://www.lums.lancs.ac.uk/files/sdaw/5707/download/. Accessed: May 29, 2006.

52   Burazeri G, Čivljak M, Ilakovac V, Janković S, Majica-Kovačević T, Nedera O, et al. Survey of attitudes and knowledge about science in medical students in southeast Europe. BMJ. 2005;331(7510):195-6.

53   Magnus RJ, Polterovich VM, Danilov DL, Savvateev AV. Tolerance of cheating: an analysis across countries. J Econom Educ. 2002;33:125-35.

54   Sowden C. Plagiarism and the culture of multilingual students in higher education abroad. ELT Journal. 2005;59(3):226-33.

55   Elzubeir MA, Rizk DE. Exploring perceptions and attitudes of senior medical students and interns to academic integrity. Med Educ. 2003;37(7):589-96.

56   Deckert GD. Perspectives on plagiarism from ESL students in Hong Kong. Journal of Second Language Writing. 1993;2(2):131-48.

57   Martin B. Plagiarism: a misplaced emphasis. Journal of Information Ethics. 1994;3(2):36-47.

58   Guide to plagiarism and cyber-plagiarism. University of Alberta Libraries. Available from URL: http://www.library.ualberta.ca/guides/plagiarism. Accessed: May 29, 2006.

59   What is plagiarism? Honor Council. Georgetown University. Available from URL: http://gervaseprograms.georgetown.edu/hc/plagiarism.html. Accessed: May 29, 2006.

60   Academic Honesty and Plagiarism. Available from URL: http://courses.dce.harvard.edu/~phils4/honesty.html. Accessed: May 29, 2006.

61   Plagiarism: What it is and how to recognize and avoid it. Writing Tutorial Services. Indiana University. Available from URL: http://www.indiana.edu/~wts/pamphlets/plagiarism.shtml. Accessed: May 29, 2006.

62   JISCPAS Avoiding Plagiarism. Advice for students. Available from URL: www.jiscpas.ac.uk/appage.cgi?USERPAGE=7510. Accessed: May 29, 2006.

63   Carroll J, Appleton J. Plagiarism. A good practice guide. First edition. Oxford: Oxford Brookes Univesity; 2001.

64   Edlund JR. What is "plagiarism" and why do people do it? Available from URL:
      http://www.calstatela.edu/centers/write_cn/plagiarism.htm. Accessed: May 29, 2006.

65   Braumoeller BF, Gaines BJ. Actions do speak louder than words: deterring plagiarism
      with the use of plagiarism-detection software. Political Science and Politics.
      2001;34(4):835-9.

66   Prijić-Samaržija S, editors. Rijeka University Ethical Code. Rijeka University. Rijeka,
      Croatia; 2004.

67   Marušić A, Marušić M. Teaching students how to read and write science: a mandatory
      course on scientific research and communication in medicine. Acad Med.
      2003;78(12):1235-9.

68   Walker JR. Copyrights and conversations: intellectual property in the classroom.
      Computers and Composition. 1998;15:243-51.

69   Breen L, Maassen M. Reducing the incidence of plagiarism in an undergraduate course:
      The role of education. Issues in Educational Research. 2005;15:1-16.

70   Hren D, Lukić IK, Marušić A, Vodopivec I, Vujaklija A, Hrabak M, et al. Teaching
      research methodology in medical schools: students' attitudes towards and knowledge
      about science. Med Educ. 2004;38:81-6.

71   Harris RA, ur. The plagiarism handbook. Los Angeles, CA: Pyrczak Publishing; 2001.

72   Kramer B, O'Brien K, Procious K, Secon M. Plagiarism and cheating in the digital age.
      Available from URL: http://www.acsu.buffalo.edu/~keobrien/lis506/paper.html.
      Accessed: May 29, 2006.

73   Lang JM. Dealing with plagiarists. Available from:
      http://chronicle.com/jobs/2002/05/2002051401c.htm. Accessed: May 29, 2006.

74   Yidong G. Research misconduct. China science foundation takes action against 60
      grantees. Science. 2005;309(5742):1798-9.

75   Teplitsky PE. Perceptions of Canadian dental faculty and students about appropriate
      penalties for academic dishonesty. J Dent Educ. 2002;66(4):485-506.

76   Osborn E. Punishment: a story for medical educators. Acad Med. 2000;7(3):241-4.

77   Van Der Weyden MB. Preventing and processing research misconduct: a new
      Australian code for responsible research. It all depends on compliance. Med J Aust.
      2006;184(9):430-1.

78   Hunter JM. Plagiarism - does the punishment fit the crime? Vet Anaesth Analg.
      2006;33(3):139-42.

79   Hren D, Vujaklija A, Ivanišević R, Knežević J, Marušić M, Marušić A. Students' moral
      reasoning, Machiavellianism and socially desirable responding: implications for
      teaching ethics and research integrity. Med Educ. 2006;40:269-77.

80   Bilić-Zulle L, Petrovečki M. Evaluation of Medical Informatics curriculum at the Rijeka University School of Medicine in Croatia. Stud Health Technol Inform. 2002;90:780-3.

81   Petrovečki M, Rahelić D, Bilić-Zulle L, Jeleš V. Factors Influencing Medical Informatics Examination Grade – Can Biorhythm, Astrological Sign, Seasonal Aspect, or Bad Statistics Predict Outcome? Croat Med J 2003;44:69-74. 3.

82   Barton BE. Six-word rule could turn description into plagiarism. Nature. 2005;436(7047):24.

83   Rennie SC, Crosby JR. Are "tomorrow's doctors" honest? Questionnaire study exploring medical students' attitudes and reported behaviour on academic misconduct. BMJ. 2001;322:274-5.

84   Rennie SC, Crosby JR. Students' perceptions of whistle blowing: implications for self-regulation. A questionnaire and focus group survey. Med Educ. 2002;36:173-9.

85   Roig M, Caso M. Lying and cheating: fraudulent excuse making, cheating, and plagiarism. J Psychol. 2005;139(6):485-94.

86   Bilić-Zulle L, Frković V, Turk T, Ažman J, Petrovečki M. Prevalence of plagiarism among medical students. Croat Med J. 2005;46:126-31.

Curriculum vitae

Lidija Bilić-Zulle, MSc, Biochem. Eng.
medical biochemistry specialist

Date and place of birth

22 March 1970, Rijeka, Republic of Croatia

Home address

Podpinjol 41

51000 Rijeka, Croatia

phone: +385 51 330 314

cell: +385 91 251 8805

e-mail: Lidija.Bilic-Zulle@medri.hr

Work address

Institute for Laboratory Diagnostics

Rijeka University Hospital Center

Cambierieva 17

51000 Rijeka

phone: +385 51 658-341

and

Department of Medical Informatics

Rijeka University School of Medicine

Braće Branchetta 20

51000 Rijeka

phone +385 51 651-255

Personal data

Married to Kristijan Zulle

Education

1984-1988 "M. Lenac" Healthcare Vocational School, Rijeka

1988-1993 Zagreb University School of Pharmacy and Biochemistry, Zagreb

1994-1996 Postgraduate studies in Medical Biochemistry, Zagreb University School of

Pharmacy and Biochemistry, Zagreb

1995-1998 Specializing in Medical Biochemistry at the Clinical Department for Laboratory Diagnostics, Zagreb University Hospital Center and School of Medicine (specialist exam passed at the Ministry of Health, Republic of Croatia, on 26 November 1998)

Academic degrees

23 December 1993 – Medical Biochemistry Engineer, graduated from Zagreb University School of Pharmacy and Biochemistry (state exam passed at the Ministry of Health, Republic of Croatia, on 23 February 1995)

13 October 2003 – Master of Science, Zagreb University School of Pharmacy and Biochemistry, Zagreb

Membership in professional associations:

1992 – Croatian Society of Medical Biochemists, Zagreb

1996 – Croatian Chamber of Medical Biochemists

1999 – Croatian Society for Medical Informatics, Zagreb

Teaching experience

1999 – teaching assistant (practicum and seminars), mandatory undergraduate course in Medical Informatics, Rijeka University School of Medicine

1999 –professional collaborator for education (lectures and practicum), undergraduate course in Medical Biochemistry within Professional Studies for Medical Laboratory Engineers, Rijeka University School of Medicine;

2006 –teaching assistant (practicum and seminars), elective course in Computer Basics, Rijeka University School of Medicine;

2006 – teaching assistant (practicum and seminars), mandatory course in Health Care Information System within Organization, Planning, and Management in Health Care studies, Rijeka University School of Medicine;

2006 – teaching assistant (practicum and seminars), mandatory course in Medical Informatics and Biostatistics within Organization, Planning and Management in Health Care studies, Rijeka University School of Medicine;

2006 – teaching assistant (practicum and seminars), mandatory course in Medical Informatics, Dentistry Studies, Rijeka University School of Medicine;

2006 – collaborator (seminars), mandatory course in Medical Research Methodology, Postgraduate Study in Biomedicine, Rijeka University School of Medicine;

2006 – collaborator (seminars), elective course in Informatics for General Practitioners, Postgraduate Study in Family Medicine, Rijeka University School of Medicine;

2006 – collaborator (seminars), elective course in Computer Literacy and Statistics", Postgraduate Study in Health Care Management, Rijeka University School of Medicine;

Work experience

1992-1993 Medical School in Rijeka, teaching Medical Biochemistry, Hematology, and Biochemistry

1994 – Institute for Laboratory Diagnostics, Rijeka University Hospital Center, Rijeka, routine, professional, and research work at the Biochemistry and Hematology Laboratory

1995-1998 University Institute for Laboratory Diagnostics, Zagreb University Hospital Center and School of Medicine, Zagreb:

- Specialization in Medical Biochemistry
- Research in the field of laboratory immunology
- Research in the field of computer program application and informatic data analysis in laboratory diagnostics

1999. Department of Medical Informatics, Rijeka University School of Medicine, Rijeka: teaching assistant in Medical Informatics (cumulative employment)

2005. Head in Charge of the Department of Medical Informatics, Rijeka University School of Medicine

Other activities

1999-2002 – President of the Croatian Society of Medical Informatics, branch of The Primorsko-goranska and Istria Counties

2000 – member of the Organization Committee of the 6th Alpe–Adria international Congress in Clinical Chemistry and Laboratory Medicine, Opatija, June 2000

2001 – member of the Organization Committee of MEDICON 2001, Pula, June 2001

2002 – member of the Croatian Ministry of Health and Social Welfare Committee for Medical Biochemistry and Laboratory Medicine

2004 – professional supervisor and auditor of the work of medical biochemistry laboratories and medical biochemists, Croatian Chamber of Medical Biochemists

2004 – statistical editor, *Croatian Medical Journal*

2005 – President of the Organizational Committee of the 7th Symposim of Croatian Society for Medical Informatics, Rijeka, October 2005

Awards

1989 – the City of Rijeka Scholarship for Talented Students

1996 – Best Poster Award at the 2nd Croatian Congress of Medical Biochemists, Pula, September 1996 (Bilić-Zulle L, Užarević B, Krašević M, Marušić M. Analysis of the tumor cell cycle by use of Mod FIT LTTM computer program)