HELPING INTERNATIONAL COMPUTER SCIENCE STUDENTS AVOID PLAGIARISM AND CHEATING

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Abstract

The preventive strategies on plagiarism and cheating among students were developed and successfully implemented in the virtual computer-science classroom using the Learning Management System (LMS) and Cloud environment. To concentrate mostly on the students' hands-on training, the "flipped classroom" pedagogy and individual or team tutoring were used in the classes.

1. Introduction

The collapse of networking industry in 1999-2000, the world economic crisis of 2008-2010, and visa restrictions for international specialists and students (that were enforced after the terrorist attacks of September 11, 2001) changed dramatically the student population in colleges and universities nation-wide (Bollag, 2004). Enrollment continues to decline in both undergraduate and graduate computer science programs (Zweben & Aspray, 2004; McCormack, 2005), particularly putting at risk small computer science programs in liberal arts colleges, which heavily depend on the international students' enrollment. At the same time, companies still demand fewer, but better prepared computer engineers with solid knowledge and hands-on experience.

According to the USA Today review, "… there are more than 500,000 open computing jobs nationwide, but less than 43,000 computer science students graduated into the workforce last year, according to Code.org, a non-profit dedicated to expanding access to computer science. The U.S. Bureau of Labor Statistics predicts there will be 1.4 million more software development jobs than applicants who can fill them by 2020" (Swartz, 2017). The Wall Street Journal confirms this data (Simons, 2017), pointing that only about 85,000 H1-B visas have been granted annually to the foreign high-tech workers.

Rob Paul, president of DeVry University, which conducted research online for Career Board Advisory Board and offers educational services that includes boot camps for tech skills, made a statement that "…the emergence of boot camps has slightly eased the problem in getting thousands of Americans up to snuff in skills for coding, Internet of Things, big data, cybersecurity and high-tech manufacturing, but doesn't go nearly far enough" (Swartz, 2017). "A fertile area is data analysis: 59% of organizations expect to increase positions requiring data analysis skills over the next five years, according to the Society for Human Resource Management and the American Statistical Association. Departments most in need are accounting and finance (71%), human resources (54%), and business and administration (50%)", the review report concluded.

All these factors have to be considered seriously and must be reflected in searching new approaches for teaching the computer science courses. In this paper, the author shares his experience (with the participation of his colleagues) in re-designing the computer science curriculum for teaching courses in

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various formats (traditional “face-to-face”, “hybrid”, and online). His teaching methods (Riabov, 1997; 2000a; 2000b; 2006a) are based on several techniques (Riabov, 2002a; 2002b; 2005b; 2006a) that challenge and motivate students to become passionate in their studies and be active in the classroom environment. Starting every class session with small challenging “warm-up” exercises (Sabin et al., 2005; Riabov, 2006a; Riabov & Higgs, 2011), the instructor encourages students to select and develop their own projects. He provides them with examples of the best achievements of professionals in the related fields of expertise (Riabov, 2004; 2005a; 2006b), the best projects of students (available on the instructor’s Website, http://www.rivier.edu/faculty/vriabov/), who took similar courses in the past, and the challenges of the discipline (Riabov, 2012a).

This paper demonstrates the advantages of using a project-based approach (Riabov, 1997; 2000a; 2000b; 2002b; 2003; 2006a; 2007; 2011) in the course delivery that motivates students in studying and learning modern computing technologies. “Warm-up” exercises, online discussions of recent research publications, lectures, and hands-on labs stimulate students in selecting topics for their technology overviews and research projects and provide them with knowledge, instruction, and hands-on experience. The students, who accept the challenge of innovation in computer science areas, display their successes by presenting their work at national and international conferences (Milkovits, 2005; Selent, 2011), publishing their project reports in the *Rivier Academic Journal* (2017), and promoting their findings among their college peers and their colleagues in companies and organizations (Riabov, 2005c; 2005d).

The paper is organized as follows. In next section the author presents a brief overview of computer science curriculum, enrollment trends, and various courses that are taught via the Canvas™ LMS and synchronous web conferencing tools at Rivier University. The core of the paper includes the sections, in which the author describes what makes the computer-science courses challenging and valuable for students, especially for those who have weak academic background and demonstrate misconducts of plagiarism and cheating. These sections also include the analysis of students’ cultural backgrounds, differences in educational systems and academic standards in the U.S. and some Oriental countries, features of a new cheating economy, and methods of preventing plagiarism and cheating among the students. The effectiveness of using the Cloud environment, the “Flipped Classroom” pedagogy, the revised styles of the course assignments, advantages of using synchronous web conferencing tools in hybrid and online course teaching and learning, and students’ responses are discussed in these sections as well. The paper concludes with Acknowledgments and Conclusions sections.

2. Curriculum Challenges and Enrollment Trends

Rivier University offers two computer science graduate programs (M.S. in Computer Science and M.S. in Computer Information Systems) in traditional (face-to-face), hybrid, and online formats. The computer-science courses that represent the core and electives of the programs have been described in (Riabov, 2013).

All the courses have three interrelated major goals:

- Introduce students to fundamental concepts in specific computer-science areas and some of their relevant applications,
- Have students take an active role in their learning by experimenting with various techniques and software tools (Riabov, 2006a; Riabov & Higgs, 2010a; 2011), and
- Instruct students in writing overview papers on modern computing technologies and in conducting their own research studies.

The courses are Web-enhanced, and a student can access remotely any course material (a syllabus, class schedule, assignments, lecture notes, lab manuals, examples of project papers and research reports, Internet links, lists of recommended readings, etc.) from the instructor's Web and Canvas™ sites. This "virtual" learning environment supports communication between students and the instructor, as well as among peers working together on a team project beyond the classroom. Also, it becomes a valuable resource for those students who have missed a class, or continue working online.

Originally, all the courses were offered in the 14-week traditional (face-to-face) format only. Since 2005, courses that do not require significant programming efforts have been transformed for offering in the 7-week online and hybrid versions (Riabov, 2013). Many graduate students employed by local companies still prefer to attend traditional and hybrid classes and participate in the lecture discussions and 'real' (not 'virtual') team projects.

The major "programming" courses in Java, C++, SQL, Python, HTTP, and XML, as well as courses involving significant student's efforts in developing and implementing algorithms or final projects, are currently offered mostly during the 14-week period, because the development of programming and algorithmic skills require longer time in comparison with the time spent for traditional lectures and labs following manuals and simple instructions (Riabov & Higgs, 2010a).

One of the major challenges of designing hybrid and online computer-science courses has been the proper choice of software tools that are the state-of-the-art (the same tools or similar ones to those used in the University labs for traditional courses) and that are available for students working at home (Riabov & Higgs, 2010a; 2011; Riabov, 2010; 2013).

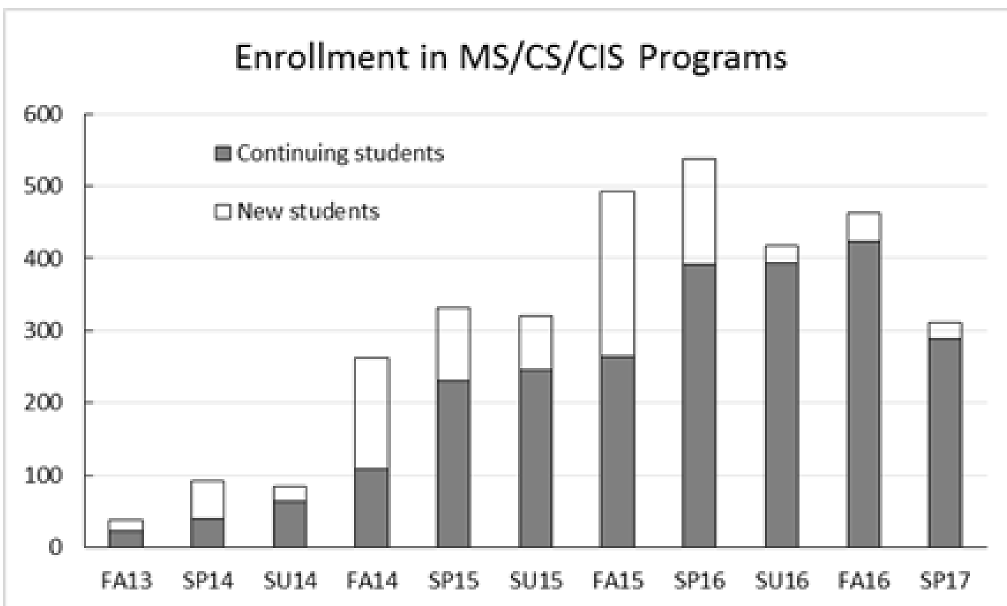

Figure 1: Enrollment in MS/CS and MS/CIS programs (fall 2013 - spring 2017)

Since spring 2014, Rivier University experiences the exponential growth of students (mostly from India) in M.S./Computer Science and M.S./Computer Information Systems programs, reaching the pick of 535 full-time students in spring 2016 (see Fig. 1 above), when 56 courses were offered. The average size of computer-science classes reached the highest value of about 25.50 in the academic year 2015-2016 (see Table 1 below). Unfortunately, since summer 2016, the number of new international students in the programs has dropped significantly (see Fig. 1), mostly due to the F-1 students' visa rejections by the U.S. Consulates.

Table 1: Average size of computer-science classes (fall 2012 - spring 2017)

Semester	FA12	SP13	FA13	SP14	FA14	SP15	FA15	SP16	FA16	SP17
Number of courses offered	7	5	7	13	39	47	54	56	45	35
Students enrolled (seats)	71	58	101	277	817	1035	1375	1428	1005	645
Average CS class size	10.14	11.60	14.43	21.31	20.95	22.02	25.46	25.50	22.33	18.43

For the last 7 academic years, 436 degrees have been conferred; the number of students has been grown by the factor of 10+. The most significant increase of students in these programs has taken place since spring 2014, when the first large cohort of 48 international students (mostly from India) arrived on campus (currently, in spring 2017, we have 311 students), who brought new challenges mostly associated with the cultural and educational-system differences, such us weak previous academic background; weak skills in the code programming; weak communication skills; numerous cases of cheating and plagiarizing; attempts to avoid challenges in studies and research by searching the existing patterns of the problem solving [that do not even work in resolving the challenging problems]; and ineffective study skills.

These new CS/CIS international students have had many distinguished features:

- All F1-visa students are motivated to study in the U.S. and receive M.S./CS and M.S./CIS degrees. Unfortunately, they do not have local roots and adequate support from the local community.
- The F1-visa status has allowed them to work on campus as Graduate-Student Employees (e.g., Graduate Assistants, Teaching Assistants, Lab Assistants, Tutors, etc.), take internship (also known as a Curriculum Practical Training or "CPT") in local high-tech companies during the studies here, and/or Optional Practical Training (OPT) for few years after the program completion [nowadays, up to 35 months]. (Typically, after CPT/OPT training, many international students got jobs in the U.S.).
- Since spring 2014, cohorts of international students were significantly different from previous small groups of F1/H4-visa students in the following ways:
    - Their actual background in Computer Science, Math, and Engineering was weak (low Cumulative GPA [well below 3.2]; low GRE scores);
    - Their actual knowledge and skills in the prerequisite areas of Computer Science and Mathematics were weak even after taking the formal CS and Math prerequisite undergraduate-level courses in India;
    - Many of them, to increase GPA, re-took several times (up to 10-15) Computer Science, Math, and Engineering undergraduate courses;
    - Many of them have had poor English communication skills, especially in Writing and Reading, with IELTS Overall Score from 5.5 to 6.0 (below minimal 6.1 required) [the tests were usually conducted by a recruiting company allocated in India];
    - The quality of their assignment reports [homeworks, labs, and projects] was very low **(**even being CS majors, they do not have experiences of producing assignment reports in basic electronic formats**);**

- Their basic professional communication skills are at very low level (e.g., fuzzy content of their e-mails, numerous requests for appointments without formulating a problem or purpose, they missed appointments without any notification, etc.);
- They never used any Learning Management System (e.g., Canvas™, Blackboard™, etc.);
- Students are self-organized into small groups, and group dynamics dominates their behavior (e.g., group members demand for enrollment in the same courses; they cheat collectively on assignments, "create" project teams with unequal participation of team members, etc.).

The Office of Global Engagement has informed occasionally the MACS Department and other offices about few cases of transfer-out (in comparison with dozens of transfer-in cases). To prevent transfer-out cases, the University administration and faculty work hard with students, who are currently on probation (38 students after Spring-2016 semester) and/or on the Academic Honesty Violation List (92 cases in AY2015-2016 only). Since spring 2014, only 3 CS/CIS students were dismissed due to the repetitive low performance (with Cumulative GPA well below 3.0) in the programs. Also there were several cases when nobody got "A"-grades in the CS courses.

To address and handle these new challenges, the CS & CIS curricula were revised, new CS introductory-level and elective courses were developed (e.g., CS505 "Computer Science Fundamentals", CS690 "Human-Computer Interaction", CS691 "Numerical Methods", CS692 "High Performance Computing", CS693 "Ruby Scripting Language", CS694 "Big Data Systems", CS695 "Intro to Carrier Ethernet", CS696 "Exploring Python"), new pedagogical principles of the course assignments were implemented (e.g., in CS505 "Computer Science Fundamentals", CS552 "Object-Oriented System Analysis & Design", CS557 "Algorithms", CS597 "Multimedia and Web Development", CS680 "Software Quality Assurance", and other courses). The students' outcomes have been revised and mapped with the directions of the Rivier University Strategic Plan and Academic Goals.

Figure 2: At the Commencement Ceremony, May 7, 2016. Courtesy photo.

These efforts have resulted in the high retention rate of the students (about 99.7%), in the growing number of internships and the Optional Practical Trainings (after graduation) (e.g., 150+ cases in fall 2015, only), and in large number of the conferred degrees (e.g., 200 M.S./CS and 65 M.S./CIS students graduated in the 2015-2016 Academic Year [see Fig. 2, above]; more than 330 CS/CIS students will graduate in May 2017).

Unfortunately, the large number of students' misconducts (cases of plagiarism and cheating) indicates the low level of the students' attitudes in professional studies. Many instructors have tried to understand this phenomenon and find the ways of preventing the students from these misconducts (Riabov, 2017).

3. Discussions on the Nature of Cheating

Some people present the argument: "the students do not really understand plagiarism and the Western demand for academic integrity". We have found that this is patently a false. A number of Rivier's students (those who work hard on assignments) have made it clear that some of their peers are simply trying to get "the grade they want" with as little efforts as possible. The cheaters have full knowledge of what they are doing.

3.1 Cheating is common and culturally acceptable in India

According to press media, cheating – using methods ranging from old-fashioned crib sheets to hi-tech spy cameras – is common in India, mostly to secure good school (or proficiency-test) grades and highly-sought government jobs. For example, India's army made candidates at a recruitment day in Bihar take a written exam in their underwear to prevent them from cheating after a spate of exam scandals in this eastern state (*The Telegraph*, U.K., March 1, 2016). The paper quoted an army source as saying they took the radical step to "save time on frisking so many people" after more than 1,000 candidates turned up. In a previous year, the police in Bihar had arrested around 1,000 aspiring officers for paying people to sit their exams for them.

In 2015, a scandal in Hajipur (in the eastern state of Bihar) that saw relatives scale the walls of a school exam center to pass notes to candidates went viral (*The Telegraph*, U.K., March 1, 2016).

In the western state of Gujarat, in February 2016, authorities blocked wireless mobile phone services in a string of cities and towns where entrance exams were taking place for public service jobs, to stamp out cheating (*The Telegraph*, U.K., March 1, 2016).

3.2 Asian students are using 'smart' spy technology to cheat in exams

Students at a medical college in Thailand have been caught using spy cameras linked to smartwatches to cheat during exams. They used wireless spy cameras in eyeglasses to capture exam questions, transmit them to associates elsewhere and receive responses through linked smartwatches. The entrance exam in question was cancelled after the plot was discovered (Chugh, 2016).

The University of Iowa suspected at least 30 Chinese students of having used ringers to take their exams. The case offers a look inside a thriving underground economy of cheating services aimed at the hundreds of thousands of Chinese kids applying to and attending foreign colleges (Qing, 2016).

3.3 The new cheating economy

More than a dozen websites now specialize in taking entire online courses, including BoostMyGrade.com, OnlineClassHelp.com, and TakeYourClass.com. One of them, NoNeedtoStudy.com, advertises that it has completed courses for more than 11,000 students at such colleges as Duke, Michigan State, even Harvard. “As cheating companies expand their reach, colleges have little incentive to slow their growth. There’s no money in catching the cheaters. But there’s a lot of money in upping enrollment.” (Wolverton, 2016)

4. Caught on Cheating

The following examples demonstrate the typical cases of cheating among Rivier’s students:

- Two students in the Algorithms course (summer 2016) have cheated on both the second and third homework assignments. Several parts of the homework were clearly copied from each other. The course instructor spoke with both students after each assignment. They both received a grade of 60 (out of 100) for the first time and a 0 for the second time. The students have been informed that, if they cheat again, they will not pass the course.
- Each of the two teams in the Computer Security course (spring 2016) submitted (as their own writing) the exact copies of IEEE publications as if it were their own work. They cut and pasted the entire documents (this was discovered using Turnitin™ tool (Butakov & Shcherbinin, 2010) in the CANVAS™ LMS environment). The course instructor took 25% off from their research paper grades.
- A student in the Java Programming course (summer 2016) attempted to purchase the solution from an online tutoring website called "studypool". The course instructor has found the image showing the student’s user name, where he has uploaded the original assignment and has put a price of $30 on it. The instructor contacted the website representative requesting the page be removed and they have complied with the instructor’s request within 24 hours. The student did not receive any credit for the assignment.
- Several students in the Data Mining course (fall 2015) used another student’s final exam answers to check their own answers before submitting, and they submitted the original student’s work (even with the student’s mistakes!) as their own. All the students got “F” grades for the exam.
- Taking the Discrete Mathematics course (fall 2015), two students took the offered in-class quiz giving the submitted answers that actually went with the other quiz and not the one they were taking. Both students got “F”s for the quiz assignment.
- Several students in the Operating Systems course (summer 2016) used the forbidden downloads during quizzes. (They used a copy of downloaded quiz solution from instructor’s manual for the course textbook). All the students were warned this behavior was cheating.
- In the Java Programming course (summer 2016), the student has submitted a program that was copied from a different version of the assignment report of the other student from fall 2015. The student got a zero score for this assignment. Another student has submitted the decompiled source code as his own. He also submitted code stolen from another website. When questioned about the first code, he admitted that the first code was not his, and he stated that the second code file was “actually his”. The instructor searched the Internet and found the second code file online. This student has got a zero score for the assignment.
- Two students in the Algorithms course (fall 2016) submitted homework #3 with the problem from the Spring-2016 semester. They each received a score of “0” for the assignment.

There are many other cases of plagiarism and cheating (in total, 105) reported by the CS course instructors since fall 2015 to spring 2017.

5. Strategies on Cheating Prevention

5.1 Offering a new "Computer Science Fundamentals" course

Starting in fall 2015, a new CS505 "Computer Science Fundamentals" course is offered as an additional (eighth) core course in the MS/CS-degree program, and the number of CS elective courses has been reduced from 5 to 4 (the total number of CS courses in this program remains the same, 12). This course is especially beneficial for students, who have no academic background in "traditional" CS/IT areas or took their CS undergraduate courses decades ago. The CS505 course introduces the students to basic concepts in computer science, as well as the knowledge and skills involved in creating software programs. At the completion of this course, the student will be able to write Java programs which use Java types, objects, arrays, methods, and classes.

Students, who might disagree with the CS Program Director to take this course, have the opportunity to take a specially-designed (free of charge) CS505 Placement Test examination (conducted usually during the Orientation Days). If they pass the test, they are allowed to take fifth (additional) CS elective course, instead of CS505 core course. (Of course, those, who fails the test, should take CS505 core course in their first semester). Since fall 2015, 67 students took the Placement Test examinations, but nobody passed the tests. After all, all these students had taken CS505 core course sections.

5.2 Introducing the "Flipped Classroom" approach

Prof. John Cupak explored the "Flipped Classroom" course-delivery model (Brame, 2013) in his CS597 "Multimedia and Web Development" hybrid course. He provided Microsoft PowerPoint™ slides, text-material readings, and videos for the students to study before each class and handed out in class the "quick reference guides" for HTML coding, for Cascading Style Sheet (CSS) editing, and for a cross-platform JavaScript library jQuery (jQuery, 2017) designed to simplify the client-side scripting of HTML. The instructor conducted a review of each quiz and assignment that was due before each class, then had the students work through in-class exercises before assigning a homework assignment related to the class topic.

While it appeared that the students were getting good quiz grades, doing the assignments and homework, Prof. Cupak decided to conduct a "review" during the week-6 class in preparation for the final exam scheduled for the week-7 class. It was during that review that he discovered that most of the students were unable to recall key concepts or provide correct solutions to problems. And, during the final exam, over half of the students copied solutions from each other.

As a result of the poor response to the review and the final exam, Prof. Cupak planed on introducing more "discovery learning" pedagogical methods in every class in which the students must recall and provide answers to questions and problems posed during the class. The student's class participation and correct answers have become a part of the grade. In addition, the instructor has stopped providing "templates" for them to complete the assignment, and he structured the assignments so the students have to create the complete web pages during every class. Prof. Cupak also put the extra efforts to reduce or eliminate copying by providing individualized data to each student.

The similar “Flipped Classroom” approach was applied by Dr. C. Thomas Wilkes in his CS505 “Computer Science Fundamentals” and CS554 “Operating Systems” classes. Being the alumni of the Georgia Tech, he uses the pedagogical approach and the CS online course concepts promoted there via the Online Master of Science in Computer Science program (Georgia Tech Online Programs, 2017).

6. Management of Computer-Science Classes

6.1 Teaching in Learning Management System environment

The technological innovations on campus (e.g., the Canvas™ Learning Management System, Virtual Desktop servers, and installation of modern computerized tools) have allowed significantly improve the pedagogical methods of instructions and provided students and faculty with modern means of communication and course management.

Canvas™ has been selected as a management environment tool for running all computer-science online (or hybrid) courses. (In 2012, Canvas™ replaced Blackboard™, significantly reducing the LMS licensing and maintenance costs). The course materials are organized on weekly basis using folders that contain “warm-up” exercises, lecture outline slides, links to software downloading sites, software installation instructions, tutorials, lab manuals, and weekly homework assignments. The individual project assignments and final exam questionnaires are allocated in the special “Assignments” section folder. The “Course Materials” folder contains examples of students’ projects from the previous course sessions, URLs to original research papers on course advanced topics, and links to additional resources available on the instructor’s web site (Riabov, 2012b). A special section on the Canvas™ site is designated to students’ project presentations and progress reports. Students are also encouraged to submit their project reports for peer-reviewing and online publishing in the *Rivier Academic Journal* (2017).

Unfortunately, Canvas™ tool (as many other online course management tools) limits live or synchronous communication (typical with face-to-face class communication) to "chat" rooms. One of the new trends in online teaching and learning is “the adoption and integration of web conferencing tools to enable live online classrooms and recreate the ethos of traditional face-to-face sessions” (Sabin & Higgs, 2007). In addition to Canvas™ course tools (e.g., Discussion Board, Blogs, Collaboration, Self and Peer Assessment, etc.), many online computer science courses at Rivier University utilize state-of-the-art web conferencing software called LearnLinc™ (2017), an iLinc™ Communications, Inc. product, a tool tailored to support “live” online learning through integration of audio and video over the Internet, text messaging, an interactive white board, synchronized browsing, and application sharing. LearnLinc sessions transform online classes into engaging, participatory, and personalized learning environments (Cooper, 2006). In the 2006-2007 academic year, Rivier University offered twelve courses, enrolling over 150 students that used the synchronous online teaching capabilities of LearnLinc. “Students who took courses [offered] in the online or hybrid format experienced a comparable level of interaction, participation, and collaboration as in traditional classes” (Sabin & Higgs, 2007). The students underlined in their course evaluations that the synchronous web conferencing helped them effectively in seeking instructor's assistance during the virtual office hours, managing time on task, and exercising problem solving skills.

Only 68% of international students (of total 147 students), who currently took CS699 “Professional Seminar” core course, got “A” or “AB” high final grades for their final capstone projects. Many of the CS699 students had difficulties in selecting new innovative topics for their projects. (More than 30% of students has tried to select well-known projects available on the Internet. They continuously violated the Academic Honesty Policies). Therefore, CS instructors are trying to find innovative pedagogical methods of how to motivate students in identifying the novel valuable topics for their projects avoiding plagiarism.

6.2 Enriching the learning environment

The cases of plagiarism and cheating conducted by international students in Computer Science programs were carefully analyzed (Riabov, 2017). Motivational and cultural aspects of misconducts were studied, and preventive strategies were developed and implemented successfully in some courses. Instead of traditional methods of plagiarism identification (e.g., by using the TurnitIn™ software (Butakov & Shcherbinin, 2010) to check the submitted written work for basic originality) and student's punishment, the project-development activities in virtual classes have been offered to the students by the course instructors, who promote using Lucidchart™ diagram-drawing tool in the Cloud environment. This approach allows them to see a history of the student's work performed, as well as the actual contributors to the design repository.

To improve preparedness of students from India for M.S./Computer Science program and those, who decided to change their majors, CS faculty developed a new core introductory course, CS505 "Computer Science Fundamentals". The course includes various topics on Java Programming Fundamentals, Data Structures, Introduction to Algorithms, and Computer Organization that will be intensively used in all other CS courses. All individual assignments are unique and have no prototypes on the Internet. Instructors encourage students to rely on their own self-esteem and avoid any forms of plagiarism and cheating.

The author completely updated a set of assignments (that do not have analogues on the Internet) for his CS680 "Software Quality Assurance" elective course, encouraging students to study the complex Java codes originally developed for various applications. Exploring industrial McCabe IQ™ tool, students conduct the complexity-code metrics analysis, predict code areas with potential errors, and make recommendations on how to improve the codes. These acquired practical skills will help students in their careers of software, test, and support engineers.

New computing tools and software development platforms were introduced by the CS faculty to students. Prof. John Cupak adapted the jGRASP™ IDE for Java and C++ code development and debugging. He also conducted extra-curricular APA training sessions for his students. Dr. David Pitts built a Linux™ cluster using the MPICH Message Passing Interface (MPI) implementation for experimentation in parallel and distributed computing. Resources for parallel programming and distributed computing also include the GNU Compiler Collection's Open Multiprocessing (OpenMP™) implementation and NVidia's Common Unified Device Architecture (CUDA™). He has also built the infrastructure for database system experimentation using open source/free database systems implementation. This infrastructure includes standard relational databases (MySQL™, Postgres™, Oracle™, and Microsoft™) and also the embedded relational database implementations such as SQLite™. Non-relational implementations are also included: XML based database systems, object-oriented database systems, and so-called NoSQL™ systems. The author has installed the newest version 8.4 of McCabe IQ™ tool for the complexity code analyses in his CS680 "Software Quality Assurance" advanced elective course. New software development platforms (Codelite™ and SDL, Cygwin™, LockDown™ Browser, NoMagic™ & MagicDraw™ UML 18.2, and Ruby™) were installed and successfully used in various CS courses.

All these software development tools were installed on the Virtual Desktop server, and they are available for all CS/CIS students in both on-campus and remotely-allocated environment.

6.3 New pedagogy in the Cloud™ environment

Dr. Keith Bagley and other instructors in the CS552 “Object-Oriented System Analysis & Design” core course start using a modified approach towards teaching the course concepts by utilizing Cloud-based UML drawing tools – Lucidchart™ and Cacoo™ – rather than traditional tools like ArgoUML™ and Visual Paradigm™. The rationale for such a move was to give greater line-of-sight visibility into the progression of students’ work on team projects, and to reduce the amount of cheating (or “copying”) that had been prevalent in earlier editions of the course. Student teams were required to share their Cloud workspaces with the instructor, so he/she was able to see the progression of their work. There was “no magic” – students knew that elements from other tools or students’ previous submissions could not be inserted into their diagrams. Further, the checkpoint reviews allowed the instructor to give direct feedback to each project team every week so that they could focus on understanding the reasons of their mistakes. Finally, the checkpoint reviews gave the instructor insight into topics that he/she needed to review a second time for the class.

After two semesters of utilizing Cloud UML drawing tools and integrating weekly team checkpoints into the CS552 curriculum, Dr. Bagley believes that his teaching effectiveness and his students’ learning performance (and retention) has improved. Plagiarism and cheating has also decreased in his CS552 “Object-Oriented Design” class, simply because it is more difficult to copy-paste existing material. Finally, the Cloud-based solutions are “ready-made” – the zero-footprint installation means that no student has any excuses for not having or accessing the software from any location. No more “my computer didn’t work” (or other “the dog ate my homework”) stories apply here since both the tool and the associated UML artifacts produced are in the Cloud.

The similar approach was used by other instructors in developing new types of lab and project assignments that motivate students to work creatively and avoid cheating and plagiarism. For example, unique code samples were offered by the author for the complexity code analyses in his CS680 “Software Quality Assurance” course (Riabov, 2011); and non-traditional capstone project topics have been offered by instructors to students in the CS699 “Professional Seminar in CS” course. The number of misconduct cases dropped by the factor of 8-12 in all these courses.

7. Conclusion

The author has described the challenges and experience of running several computer science courses for graduate international students, who have weak academic background in CS/IT areas and demonstrate misconducts (plagiarism and cheating) that have cultural roots in differences of educational systems, academic standards, and pedagogy. New methods for preventing the misconducts have been developed and explored: the thorough revision of the CS curriculum and introduction of a new foundation core course; the wide system of academic support (individual and group tutoring; faculty extended office hours; opportunities of on-campus jobs, internships, and Optional Practical Trainings in high-tech companies); the “Flipped Classroom” pedagogy; development of students’ projects in the Cloud environment, and revision of all course assignments making them unique and unavailable on the Internet. Also, the author’s experience in selecting free-license software tools for the courses has been in general a very positive one, while at the same time providing useful lessons learned. He believes that the virtual-lab and challenging project-based approach can be effectively applied to future courses of a similar nature in academia. In his experience of running face-to-face and hybrid courses, the author has found that the use of synchronous web conferencing tools (in addition to traditional Canvas™ course tools) helped students in effectively seeking instructor's assistance, time-management of tasks, and exercising problem solving skills. These efforts have resulted in the high retention rate of the students (about 99.7%), the growing number of internships and the Optional Practical Trainings (after graduation) (e.g., 154 cases in fall 2015, only), and the large number of the conferred degrees (e.g., 200 M.S./CS and 65 M.S./CIS students graduated in AY2015-2016, and more than 330 CS/CIS students will graduate in May 2017).

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