*SOCIETY. INTEGRATION. EDUCATION*
*Proceedings of the International Scientific Conference. Volume I, May 25th-26th, 2018. 464-475*

# UNIVERSITY LEVEL TEACHING STYLES WITH HIGH SCHOOL STUDENTS AND INTERNATIONAL TEACHING AND LEARNING

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***Abstract.*** *The main aim of this paper is to render how university level courses are taught in high school. In fact, we will focus on what styles are used to teach university level courses and illustrate the international contrasts that happen quite frequently. In addition, we will analyse the details of teaching styles that were implemented in the American and the Latvian educational systems. Furthermore, we will discuss what specific teaching styles and innovations work successfully, and what teaching styles and innovations had difficulties and need improvements. In particular, implementing the hands-on teaching and learning styles and repetitive type teaching and learning styles. Moreover, we will also discuss the risk involved with introducing and transforming university level courses and teaching styles with high school students and how to manage these risks.*
***Keywords:*** *hands on teaching style, international learning, international teaching, repetitive teaching style, risk analysis.*

## Introduction

It is of paramount curiosity to try new teaching methods in the classroom, especially if we are teaching the same course several consecutive semesters. In addition, when teaching a completely new course it would be interesting to recycle old techniques that successfully worked in the previous courses taught and try new ideas and innovations (Huberman, 1983). Furthermore, we can extend these ideas when we teach the same course or new course in a different educational system in another country (Spendlove, 2007; Radin & Riashchenko, 2017); that of course becomes a bigger challenge and adventure as we are not so familiar with the new system and with the new culture (Radin & Riashchenko, 2017). Thus it is a riveting journey to cross barriers that create these interesting, yet arduous challenges at times. Moreover, a more exciting challenge will be to try to


*http://dx.doi.org/10.17770/sie2018vol1.3321*

transition successful teaching styles and methods in the university classrooms with high school students (Panagiota, Stavrakouli, & Vasiliki, 2016). The vital questions that we will address in this paper are: How successfully will the new ideas work (Tomlinson, 2005)? What problems can occur? How do we adjust these problems (Rosenfeld, 2014)? How do we minimize the risk when we apply new ideas and innovations in the classroom and outside the classroom (Radomska, 2014)? We will discuss how to minimize the risks in the later section of the paper.

In addition, revising teaching styles and being innovative inside and outside the classroom is critical as students' learning styles change from year to year and from generation to generation, due to frequent reforms in the educational systems, due to enhancement of technology and due to international influences as well (Brent & Felder, 1996; Khnyfr, 2005). Especially it is salient to keep up with all these changes and updates that occur on the regular basis (Briere, Macsuga, & Simonsen, 2012). In addition, many international factors also influence new teaching styles and innovations, especially in the American educational system and in Latvian educational system (Radin & Riashchenko, 2017).

The aim of this paper is to portray how interactive, hands – on and repetitive teaching and learning styles have served as the fundamental key to students' academic success and how these innovations enhance the positive learning classroom atmosphere; in the classrooms of American universities and high schools and Latvian universities and high schools. In particular, we will discuss how these particular pedagogical innovations successfully solved several problems as low classroom attendance and low classroom participation which result in poor academic performance. In addition, these specific pedagogical innovations enhanced the communication with students outside the classroom by increasing participation during weekly scheduled office hours and stimulated the students' efforts on the weekly homework assignments. We will also conduct a cross – cultural analysis in the classrooms of American universities, American high schools, Latvian universities, and Latvian high schools. Furthermore, we will compare the differences in the students' preparation levels, students' learning styles, and cultural differences between the American students and Latvian students and how to change and adjust the innovations in the classrooms of Latvian universities that work successfully in the classrooms of American universities. In addition, we will discuss the challenges that can arise when implementing university level teaching styles with high school students and how to handle these challenges. We will apply the data from the last 15 years using regular feedback from the student evaluations and feedback from colleagues. In addition, we will compare the student evaluations before the implementation of the innovations and after the implementation of the innovations. Moreover, student evaluations have been written by more than 800 students from Rochester Institute of Technology, 50 students from Transportation and Sakaru Institute, 60

students from Liepaja University and Liepaja Gimnazia and 30 students from Riga Technical University.

## Hands-on Interactive Teaching and Learning Styles

One of the key factors of teaching innovations in the American educational system is to design a more hands – on teaching and learning atmosphere in the classroom and outside the classroom (Hake, 1998). Now the vital question to address: how do we enact these new ideas and innovations (Shields, 2003)? For example, many American universities such as Drexel University and Rochester Institute of Technology offer undergraduate engineering programs that require students to do co – ops or internships by working in a company or for a government agency for at least one semester as part of graduation requirements. How do we proceed with hands on education beyond the scopes of the engineering programs? Several business programs also started offering hands – on education with many hands – on analysis courses. Can this be also be done with high school students to get them prepared to university level education (Matthew, 1996)? In fact, several of these ideas have been implemented already with high school students as co-teaching (Cook & Friend 1995). Several high school in America offer STEM university level programs to their students.

The next fundamental question to address: how do we start hands – on education earlier with freshmen (first year students in American universities)? To address this question, we will share some of Michael Radin's successful teaching styles and innovations at RIT and in Latvia. While teaching his freshman calculus courses Michael introduced the hands – on teaching and learning style with bi – weekly worksheets. Offering students additional hands on practice in addition to regular classroom lectures. During these workshops, students work on problems either in groups or on their own and get guidance if questions or difficulties arise. Michael designed his worksheets with repetitive type problems that give students chances to work out the details a few times and understand the sources of their frequent mistakes that occur in the learning process. Furthermore, this was a golden tool for Michael to monitor students' common mistakes and emphasize them to his students. In fact, these innovations helped Michael decrease the amount of D's and F's (unsatisfactory grades in the American educational system) in his classes by 20 % as he started to implement them. Moreover, 90 % of the students recommend other students to take his classes.

Michael also introduced this hands – on teaching style when teaching his SAT (Scholastic Aptitude Test) and GRE (Graduate Record Examination) preparatory courses at RIT; these are preparatory courses that prepare students to succeed on the entrance exams to American universities. This was an idea that one of his students suggested to him six years ago to digitize the worksheets and

give students real problems to practice that appear on these entrance exams. Michael then designed them similar to his worksheets in his freshman calculus courses with repetitive type problems that offers students opportunities to understand and fix their mistakes. These innovations were successful as at least 90 % of the students recommend to take this preparatory course. We will discuss the principles of repetitive teaching and learning style in the later section.

During his spring 2016 semester sabbatical Michael spent teaching courses in different universities in Latvia. Michael introduced his hands – on teaching style as he taught Introduction to Discrete Mathematics at the TSI (Transportation and Sakaru Institute). Instead of providing worksheets as he did in his courses at RIT, Michael assigned students weekly homework assignments and would give students opportunities to work on problems during class. How did the students react to his innovations? The first students' reaction: how are we supposed to solve the problem when you have not taught us anything yet? Michael then explained to the students that you do not learn as effectively by watching others; "You have to try it yourself" and offered the analogy that you do not learn to drive a car by watching someone driving a car. It took the students about two weeks to get acclimated to this new hands – on teaching and learning style and gave Michael very positive teaching evaluations. Michael took a risk by implementing his American hands – on teaching style and did experience some problems with cultural differences between America and Latvia but fortunately he was able to convince his students why this will help them widen and enhance their knowledge of the material. We will discuss more strategies how to minimize these potential risks in the later section of the paper (Radomska, 2014).

In addition to teaching at TSI, Michael also taught courses at Liepaja University. While Michael was teaching at Liepaja University during the spring 2016, Dagnija Deimante-Hartmane (English Teacher) from the Liepaja Gimnazia asked him to teach a university level mathematics course for their high school students. Michael then decided to teach a different version of his hands – on Discrete Mathematics course as this course can be taught with minimum amount of arithmetic. The class was small size and the students were in the third year of high school with very strong preparation. However, as Michael was not aware of the students' preparation and did not ask the administration any questions about their preparation. Therefore, to minimize the risk of problems Michael started out with material that had no arithmetic and perpetually integrated arithmetic and got a sense of the students' preparation level. His instincts were right as even very well prepared students experienced problems with the arithmetic but did gradually work them out by working on numerous repetitive types of problems. Students gave Michael very positive evaluations, and Dagnija Deimante-Hartmone and the Gimnazia Principal were very pleased with Michael's contribution to the school.

Olga Orlova is currently a Doctorate Student in mathematics at Munich Technical University. Before coming to Munich Technical University Olga did her master's degree at Tallinn Technical University. In addition, Olga had the opportunity to study in the American educational system at the University of New Mexico during the spring 2016 semester. Furthermore, while studying at the University of New Mexico Olga experienced the American hands – on learning style with voluminous amount of homework assignments assigned in all her courses. This caught Olga off guard, as she was not prepared to do this large quantity of homework assignments. She then understood the American principal of education that at least 80 percent of the learning occurs outside the classroom. This was certainly a cultural shock to Olga as a student as there were not homework assignments in her math courses at Tallinn Technical University. However, she did gain a very valuable life learning experience with the repetitive hands on education outside the classroom and helped her understand the fundamental differences in learning and teaching styles that can occur in different educational systems and how to vital it is to acclimate in order to succeed (Hake, 1998; Smallbone & Quinto, 2010).

Furthermore, Olga had the opportunity to switch roles and gave mathematics lessons herself to several middle school students. She did it as a part of a charity project at Tallinn Children's Home. Her task was to give private lessons to students who either had difficulties catching up with the rest of the class or simply wanted to improve their level of knowledge. Sometimes students were not motivated to work on the standard textbook exercises and felt really bored. Olga then decided to experiment with introducing some university level mathematics using hands – on teaching and learning style. Namely, she did not introduce abstract theoretical concepts (which middle school students are clearly not yet ready to grasp), but tried to bring forward the meaning behind the formulas which she explained in simple words and using examples. She started with a problem statement and encouraged students to think about how to solve the problem and at the same time giving them some hints on how to apply university level math concepts, such as numerical integration or modular arithmetic. Thus, even the weaker students were able to solve the problems, as they did not get lost in incomprehensible theory and understood the essence of the problem clearly. Moreover, the feedback from the students was very positive – they claimed that university level assignments were more interesting to solve than the standard exercises.

## Repetitive Teaching and Learning and Practical Experiences

As we discussed in the previous section, repetitions can serve as a very vital tool in implementing successful teaching and learning styles. In fact, repetitions

perform as a very crucial fragment during the learning process when studying music and learning to play a musical instrument, when studying a foreign language, and during sports practices (Murgulis, 2012; Yakovlev & Yakovleva, 2014). In addition, psychologists analyse sometimes thousands of repetitions in particular behaviour(s) before coming to any conclusions. Furthermore, the department of transportation analyses repetitions in traffic patterns numerous times before they make any decisions to do any construction projects. From previous teaching and learning experiences, repetitions serve as a vital tool in teaching and learning as students start to realize their mistakes after solving several repetitive types of problems. Furthermore, teachers start to detect students' frequent mistakes after solving several repetitive types of problems, can emphasize the common mistakes to their students and recognize the differences in the students' varying learning styles (Grasha & Yangarber-Hicks, 2000; Iyer, Tversky, & Zacks, 2001).

The next pertinent question to address: how to implement repetitive teaching and learning in the classroom? Majority of repetitive learning occurs outside the classroom when students work on homework assignments. In addition, how to implement these particular teaching innovations with high school students? To answer these questions partially we will provide some examples from personal experiences.

While teaching courses and conducting seminars in various universities in Latvia, Michael Radin had the opportunity to work with several high school students individually one on one and gradually introduced them to university level mathematics. Michael's first experience was with Victor Zommers from Jurmala Jaun Dubulti School in Jurmala, Latvia. Michael worked with Victor one on one by giving him several repetitive type practice problems on fractions, decimals, solving linear equations, solving quadratic equations, geometry problems, word problems, and problems with integers. After two years of such practice, Michael invited Victor with the challenge to take the university level Introduction to Discrete Mathematics course that Michael taught at TSI (Transportation and Sakaru Institute) during the spring 2016 semester. This was the first time that Victor took any university level course. Therefore, the initial experience for Victor was quite immense; in particular, learning new material that he has never seen before and experiencing the new learning atmosphere with university level students only as a second year high school student. Despite the fact that he had two years of training, it took him almost a month to get acclimated to the rhythm. He had to catch up by asking many questions outside the class during office hours and do additional repetitive type problems before the material started to sink in. It was a challenging transition for Victor but a very positive and influential experience that he gained. Moreover, this experience helped Victor to get accepted and succeed at the IB International School in Denmark.

In addition to working with Victor, Michael also had the opportunity to work with Alexei Timchenko, who was a second year high school student in Riga Purvciems Secondary School in Riga, Latvia. Similar to his experiences with Victor, Michael also started to work with Alexei on similar type of repetitive type problems. Furthermore, Michael worked with Alexei on university level calculus from an American textbook: limits, derivatives, integrals, sequences and series. After two years of practice and experience, Alexei was ready for the challenge to take Multivariable and Vector Calculus course that Michael teaches at RIT via skype. This was the first university level course for Alexei as a third year high school student and the first course that Alexei took in English. It took a month for Alexei to sink into the rhythm and he had to ask Michael many questions and work on more repetitive types of problems one on one between the classes via skype to catch up. This experience helped Alexei to succeed when he started his bachelor's studies in the Department of Biological and Medical Physics in Moscow Institute of Physics and Technology in Moscow, Russia. Therefore, from his experiences with Victor and Alexei, Michael acquired new valuable knowledge about balancing out the cultural differences in the American educational system and the Latvian educational system and different learning styles too (Jerkins, 1991; Lynch, 2008; Matthew, 1996; Rosenfeld, 2008; Spendlove, 2007).

## Problems and Potential Risks

In the previous section, we shared about some of the successful experiences with implementing methods and innovations to teach high school students university level material (Graziano & Navarete, 2012). However, there were necessary adjustments that were pertinent to resolve some of the problems. Therefore, there is always risk involved that is essential to consider with problems that can occur during the implementation. Now we will ask the rudimentary question: Why there is a risk and what possible problems can arise (Brent & Felder, 1996)? First of all, anytime an idea or innovation is implemented, there is never 100 % that it will be successful (Radomska, 2014). Second of all, problems can occur due to different preparation level of students, due to different learning styles of students (Jerkins, 1991), and due to cultural differences (Radin & Riashchenko, 2017).

For example, Michael Radin has been teaching his hands – on SAT preparatory course at RIT with repetitive types of practice problems for 12 years. Recently Michael was invited to teach the SAT preparatory course at the Rochester Preparatory School in Rochester, New York. Michael applied the same teaching style with repetitive types of problems that he designed while teaching the course at RIT, but very swiftly discovered the students were not ready for this

hands – on style that required them to solve problems on their own during class instead of watching the instructor solving the problems. Michael noticed that these students needed more guided examples and even more repetitive types of problems to get into the rhythm as their preparation level was much weaker than to what Michael was acclimated to. In addition, they were not used to this paste either that Michael was teaching. Furthermore, Michael had to emphasize the main principles much more frequently than in his previous experiences. However, after teaching this preparatory course at the Rochester Preparatory School for the first time, Michael gained valuable experiences and took the opportunity to revise his worksheets with more guided examples and with more repetitive types of practice problems. Moreover, Michael had to teach this preparatory course at a much slower paste than before. The important lesson Michael learned is to expect different learning styles, preparation levels of students and to be prepared to make the necessary adjustments (Jerkins, 1991; Grasha & Yangarber-Hicks, 2000).

The question is not if problems occur during implementation, but how to minimize the risk, how to make future improvements and confront challenges that will arise (Lynch, 2008).

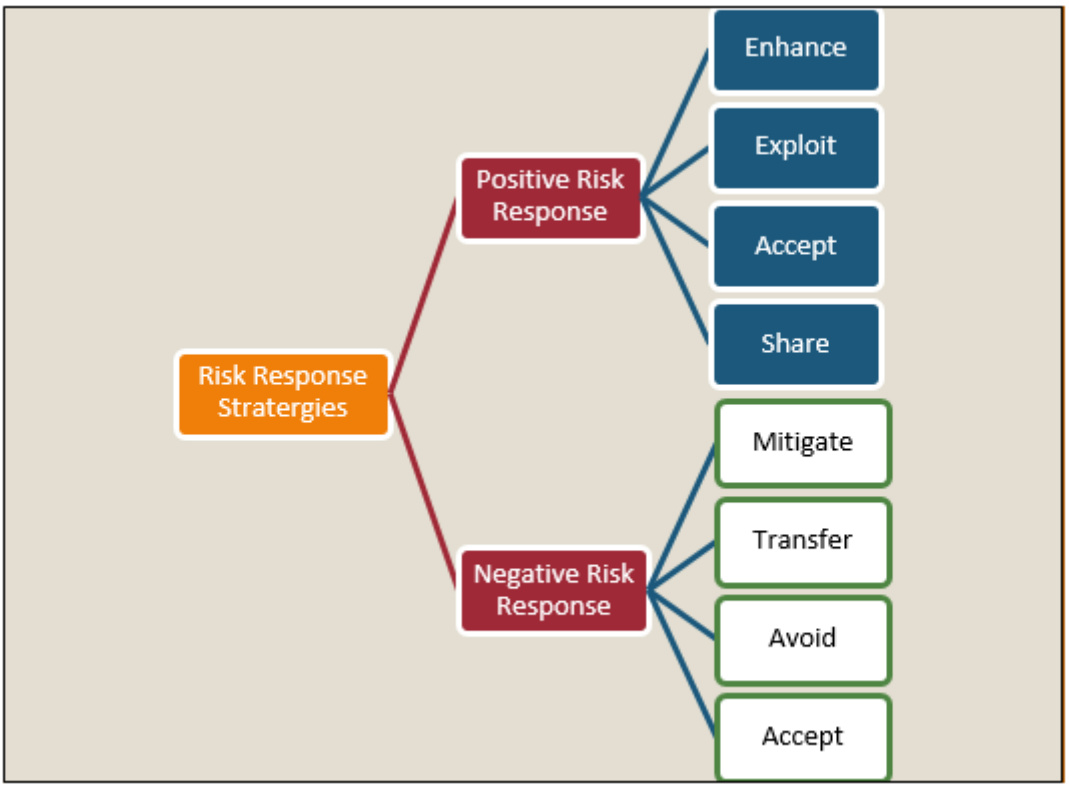


Figure 1. **Risk Management Diagram prior to implementation**

The first step to minimize the risks of failure of a new potential idea or innovation in the classroom is to get feedback from the supervisors or the

administration (Radomska, 2014; Rosenfeld, 2008). In fact, present the idea(s) will all necessary details. It is vital to convince the administration why the innovation will be advantageous to the school and to the students. From Figure 1, the vital question to emphasize: How will the innovation(s) enhance the students' learning and their performance? It is crucial to persuade the administration how and why the innovation will be beneficial. Furthermore, once the administration agrees then it is even more pertinent to their advices and their guidance in the right direction. It is even more crucial to understand that the administrators may see details that teachers do not necessarily see. For example, during June 2017, Michael Radin conducted his seminar on "Developing and Establishing Successful International and Interdisciplinary Research Coalitions" at Riga Technical University in Riga, Latvia. However, before conducting this seminar, Michael consulted with the head of Doctoral School and got several feedback and advices that gave him very beneficial ideas, and thus lead him in the right direction with making several revisions before implementing the seminar. This was the first time that Michael conducted such a seminar and certainly was not yet familiar with the diverse academic atmosphere of graduate students at Riga Technical University. Michael did receive positive evaluations from students; in fact, 84 % of the students were happy with the seminar but did have some suggestions on future improvements.


Figure 2. **Strategy Implementation Diagram**

Therefore, the second pertinent step is to get feedback after implementing the innovations from the students (Shuell, 1986; Smallbone & Quinton, 2010). It is especially vital to make changes and improvements from the feedback before implementing the innovation the second time around. Actually, during the implementation of a certain idea or innovation each time, it is beneficial to assess the students' learning styles and the overall learning atmosphere and make the necessary changes to lead in the right direction as we can see in Figure 2. In fact, while Michael Radin worked with his students Victor Zommers and Alexei Timchenko, he had to make several adjustments to adapt to their learning styles, as they were high school students from Latvia studying university level mathematics. In fact, using the cycle in Figure 2, Michael carefully assessed each distinct situation to design a productive and fruitful learning atmosphere for them.

## Conclusions and Future Innovations

In the previous sections, we shared about several successful experiences and some risks and problems can arise during the implementation process due to different preparation levels, different teaching and learning styles, cultural differences and university vs. high school learning atmosphere. Last May 2017 Michael conducted the Annual Math Olympics in American Style event in Riga, Latvia. Michael conducts this annual event in Riga and almost 100 students from 16 different school districts participate in this event each year during the last four years. While conducting this event, students from Riga Technical University High School asked Michael to teach a course for them on graduate level, as these students know Michael’s colleagues from Riga Technical University Department of Artificial Intelligence and Systems Engineering with whom Michael published three research papers. This was the first time that high school students asked Michael to teach such a course. On one hand, it was flattering, and, on the other hand, quite a challenge to some way teach graduate level material on a high school level. From Figure 1, Michel immediately discussed this possibility with the administration from Riga Technical University and got positive feedback to teach such a course. However, he did get several suggestions to teach it as an interdisciplinary course that would also be accessible to students from other school districts in the city of Riga. After his meeting with the administration, Michael wrote a course outline with all the details and received vital feedback and suggestions with what topics to add that would be beneficial to the students. Furthermore, while Michael was designing his lesson plan, the administration also indicated what to omit and what to include.

**Acknowledgements**

In closing, we would like to take the opportunity to thank our colleagues in Riga Technical University, Transportation and Sakaru Institute, Liepaja University, Liepaja Gimnazia and Rochester Institute of Technology for their support and guidance during the vital process; especially before and after the implementation of several pedagogical innovations. Their guidance and feedback contributed to many successful implementations and also lead to discovery of new innovations yet to be implemented with university students and with high school students in the American and Latvian educational systems.

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