

## New Pedagogical Approaches to Induce Sustainable Development Goals

*Jose Carlos Quadrado* – PhD, DSc, Prof., Vice-president, e-mail: ipp@ipp.pt  
Instituto Politécnico do Porto, Portugal

*Address:* Rua Dr. Roberto Frias 4200-465 Porto, Portugal

*Kseniya K. Zaitseva* – Cand. Sci. (Education), Assoc. Prof., e-mail: kkzaitseva@gmail.com  
Tomsk Polytechnic University, Russia

*Address:* 30, Lenin prosp., Tomsk, 634050, Russian Federation

**Abstract.** High quality professional training in accordance with the principles of outcome-based approach depends on the learning outcomes students are expected to achieve upon graduation from the educational program. However, the definition of a set of core competencies is just one of the steps that have to be fulfilled, but not enough for successful achievement of intended learning outcomes by the students. The paper considers the role of teaching and learning methods in designing and implementing of educational programs.

Flipped Learning is becoming a well-known pedagogical approach in which direct instruction moves consistently from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.

Education of the next generation of practitioners that will creatively implement the Sustainable Development Goals (SDG's) by 2030 requires the complete rethinking by the educator how to do the job being done on a certain way for years. The flipped classroom model addresses how students learn best and become more engaged. Discussions and hands-on activities tend to keep students' interest. While educators work with students directly as they explore the concepts they're learning in class, they can provide immediate feedback that helps students improve their learning as they go.

The students pursuing the SDG's creative engagement in classrooms become better at taking the lead on finding valuable resources and pursuing learning their own way using the flipped learning. This approach explores a specific challenge in the development of education and practice.

**Keywords:** sustainable development, flipped classroom, engagement, students' motivation

**Cite as:** Quadrado, J.C., Zaitseva, K.K. (2018). New Pedagogical Approaches to Induce Sustainable Development Goals. *Vysshee obrazovanie v Rossii = Higher Education in Russia*. Vol. 28. No. 3, pp. 50-56.

DOI: <https://doi.org/10.31992/0869-3617-2019-28-3-50-56>

### 1. Introduction

The traditional lecture style of teaching persists in both primary and secondary schools, even at higher education level. In fact, students are comfortable with this method, and most of them consider it as a good educational strategy [1]. In order to offer a different model, recently, an innovative teaching model has been developed – the inverted or flipped model.

With this methodology, the students are able to acquire the learning outcomes outside of the classroom, usually using information and communication technologies (ICTs) such as online educational tools, screencast or recorded videos, meanwhile class time is reserved for practice assignment, targeted remedial work or activities designed to promote higher-order cognitive skills [2].

Nevertheless, not all aspects of flipping are new. In traditional education contexts, the teacher expects students to come to the classroom prepared, such as having read or done assigned material [3]. The difference is marked by the huge advance of ICTs accessible for both students and teachers [4], which allow the inverted classroom to become a reality.

The way to approach the flipped classroom can vary, but all of the different models are basically the same [5]. Learning is not limited to the classroom, so students should take responsibility for their own learning, becoming more flexible and adapting to this individualised methodology.

Another advantage of this methodology is that it can be combined with other innovative educational tendencies, such as the use of cognitive tools. Although the use of ICTs makes the flipped classroom implementation feasible, researchers have observed that the majority of educators are still adopting technology passively as a learn-from medium [6].

Such disappointing results force educators to reform the teaching to enhance creative learning environments that allow students to solve realistic problems and develop higher-order cognitive skills [7]. In order to achieve this goal, the ICTs can be effective tools, being transformed into cognitive tools if they accomplish the following characteristics: support students' decision making, support students' metacognitive processes, enable students to organize, evaluate and analyse information, facilitate students' problem solving and allow them to collaborate and communicate ideas in multi-modal formats [8; 9].

This is a difficult task, since the use of cognitive tools involves not only grasping the content knowledge, but other higher order thinking skills such as: critical, logical or deductive thinking, etc. [6].

Apart from developing cognitive skills or learning content knowledge, the flipped classroom has the goal of motivating the students for learning, and it has been developed through different education methodologies, which can be used in combination with inverted classrooms to enhance the students' interest. One of these is

gamification [10–12]. It has been implanted with positive results in several curricular programmes [13; 14] and organizational settings [15].

Nevertheless, its implantation in higher education is limited [16], since if the assessment is not well balanced, it can induce a decrease of interest instead to promote an extra motivation.

For the practitioners in the sustainable development goals, the flipped classroom is an innovative educational methodology, flexible enough to incorporate other teaching strategies such as expert workshop [17], which is becoming a powerful tool to enhance the students' motivation and engagement in order to achieve learning goals.

## 2. Objectives

Students don't all learn at the same pace and in the same ways. That's always been a complicating factor in teaching. The question of how to meet thirty or more unique students at their own levels is one that keeps teachers up at night.

The flipped classroom model gives the educators more opportunities to work directly with students. With this approach, the educators can clearly see when an individual student is having trouble with a concept and work with him directly to get through it. The increased interaction with students in the classroom will also help the educators to gain a clearer idea of the different learning styles of their students, so they can tailor their instruction to the needs of each one. This is even more important when the student's backgrounds are diverse, as is the case of the MDP students.

A student sitting in a conventional lecture, diligently taking notes will almost certainly miss one thing the professor says while writing down another. And that's still a vast improvement over the student whose mind wanders so he doesn't catch much of anything. The flipped learning allows the students to work at their own pace. The students have more power over the way and the process by which they study and learn.

The purpose of the present study is the description of an innovative teaching project at higher education level, particularly, the implan-

Table 1

Learning goals and learning outcomes proposed

Learning Goals	Learning Outcomes
Learning by Experience	Apply the SDG's concepts in field
Learning to Learn	Be able to perform an experimental design
Critical Thinking	Be able to summarize and present to peers a research article
Logical Thinking	Be able to apply the theoretical knowledge in a practical case
	Be able to solve complex problems by applying the knowledge acquired

tation of flipped classroom in specific subjects for the next generation of practitioners that will creatively implement the Sustainable Development Goals (SDG's) by 2030.

### 3. Methodology

#### 3.1. Context and students

The innovative teaching project will be applied at Instituto Politécnico do Porto (P.PORTO), in the Masters in Development Practice programme (MDP). The degree is composed of 2 academic years including a field practice and dissertation/internship in the second year.

This programme was designed to be fully compatible with the other existing MDP's including the joint offered global classroom to reinforce the potential of the outstanding students in order to help them to achieve the highest academic and practitioner performance required in the second year of this master course.

The teaching project will be applied in the two "Foundation: Analysis, Conceive and Design" subjects, which correspond two semester courses (a total of 10 ECTS) in the first year of the MDP. The subject is considered as an interdisciplinary training course that better prepares the students for the practitioner work [18].

#### 3.2. Learning goals and outcomes

The teaching project has been designed to develop the following learning goals and outcomes (Table 1).

#### 3.3. Participants and class process

Before the inclusion of this methodology in the Foundations subjects, by design, included ten

seminars, which consisted of: global classroom presentations in the classroom by international specialist on a specific SDG's topic in addition to local experts in relation to the latest national state-of-the-art in relation to the same subject.

The teaching activities, here described, will be carried out from October to June, taking place one per every two months. The material will be delivered through the P. Porto proprietary on-line educational platform, DOMUS, which integrates the Moodle and is available for both students and teachers. This educational platform includes a great variety of options, such as a description of teaching guide, calendar, gradebook, announcements and different tools for communicating with the students: mail or chat (forums). Also, it includes a folder with resources, and a section to perform tests/quizzes and assignments.

Also, this platform enables the delivery of the material, such as scientific articles, guidelines for the activities, extra-material, screencasts or exercises, but also the students will be able to upload their posters, presentations or any other assignments requested. A forum will be created to enhance the communication not only with the teacher responsible for the activities but also among classmates.

#### 3.4. Teaching activities and assessment

The teaching activities have been designed in order to enhance the following: learning outcomes, knowledge to learn and skills to develop.

The five teaching activities are total 15% of the full subject score. After each activity and prior to the next one, the teacher will deliver the individual marks to be consulted by each student.

With the aim of motivating the students, the teaching project includes an innovative methodology of assessment, namely, gamification. As if it were a game, the students will be ranked depending on the mark they have obtained after each activity. We will establish three categories: 33% with the best marks will be placed in the first category, the following 33% of the best marks – in the second category, and the rest – in the third category. Those students who are located in the first category will achieve the maximum score (15%), the students placed in the second category will achieve 10%, and the last ones will be given 5%. However, in order not to punish any students excessively, the teacher responsible for the activity will be able to increase the mark up to 3% more for those students who have accomplished the learning goals.

The individual score will depend on the indicators of achievement for each learning.

#### 3.4.1. Task 1 – Learning based on projects: Apply the SDG's concepts in field

Based on a real case (“field practicum” previous projects) outside of the classroom, the students should be able to analyze how to proceed in specific situations in the terrain. Once in the classroom, the teacher responsible for the activity will comment on the most common errors and possible doubts and it will be possible to open a discussion about the ethical needs to act accordingly during “field practicum” experimentation.

Learning outcome: Apply the targets of the SDG's in a field practicum experimentation.

Knowledge to learn: The SDG's objectives and targets.

Skills to develop: Autonomy and personal initiative.

Description of the indicators of achievements:

- Knows how to apply the local rules and regulations during the “field practicum”.
- Is able to identify the most relevant SDG's to intervene upon.
- Has been demonstrated autonomy to develop the activity.

#### 3.4.2. Task 2 – Carry out your own experimental design

The design of experiments including living beings is a responsibility and needs prior knowledge. The students, in groups of 2, will design a field practicum experiment following the guidelines of the activity, which later on will be presented in classroom through ICTs. The teachers will point out the possible errors or doubts after each presentation.

Learning outcome: Be able to perform an experimental design.

Knowledge to learn: Learn the basic principles of designing a field practicum experiment including how to relate to the surroundings in a real field practicum situation.

Skills to develop: Oral communication, teamwork, creativity.

Description of the indicators of achievements:

- Knows how to design a feasible experiment.
- Knows the procedure of designing an experiment including living beings.
- Shows creativity.
- Develops oral skills.

#### 3.4.3. Task 3 – Show me what you know

The ability to obtain the most relevant information and show it in an attractive manner is a difficult task which requires specific training. The students, in groups of 2, will elaborate a scientific poster from a research article following the criteria described in the guidelines. In the classroom, after students give a brief description of the research described in the poster, the teacher will point out the possible errors and improvements.

Learning outcome: Be able to summarize and explain in a presentation a research article.

Knowledge to learn: Learn how to obtain the most relevant information from a scientific article.

Skills to develop: Synthesis, creativity and oral communication.

Description of the indicators of achievements:

- Ability to synthesize.

- Improve the reading comprehension of scientific literature.
- Show creativity.
- Develop oral skills.

#### 3.4.4. Task 4 – Development

##### Goals on Internet

Internet provides a huge amount of information and is a powerful tool for both students and educators. Nevertheless, it is necessary to be extremely critical and verify if the information can be used or trusted. Taking this idea as the basis, the students (in groups of 2) should search Internet (digital press, blogs, chats, etc.) for relevant news in relation to the subject, making an oral presentation in the classroom showing a list of possible fake news items in contrast to others that can be trusted. Once the presentation is finished, an open discussion will be initiated concerning the dangers presented by fake news in relation to health.

Learning outcome: Be able to apply the theoretical knowledge in a practical case.

Knowledge to learn: Learn to contrast the information.

Skills to develop: Critical thinking, ability to seek information.

Description of the indicators of achievements:

- Ability to find information.
- Critical thinking.
- Ability to transfer theoretical knowledge to resolve practical cases.

#### 3.4.5. Task 5 – Find out who is to blame

One of the most difficult tasks is to apply the theory to solve a real problem. In the current activity, the students will watch recorded videos in relation to the effects of interventions in the society. Later on, in the classroom, the teacher will provide the students (in groups of 2) with the description of a disease. The task will consist in finding out which are the causes of the problems and which actors are involved.

Learning outcome: Be able to solve complex problems by applying the knowledge acquired.

Knowledge to learn: Learn how to impact the society.

Skills to develop: Logical and deductive thinking.

Description of the indicators of achievements:

- Ability to solve complex problems.
- Ability to transfer theoretical knowledge to resolve practical cases
- Develop logical thinking.
- Improve deductive skills.

A suitable solution for the problem is what will be evaluated, which will be delivered to the teacher responsible for the activity before the discussion of the different answers and the correct solution in the classroom.

## 4. Conclusions

The change of focus achieved is substantiated, describing in detail the process of helping the students with the process of learning – how to learn better on their own, rather than teaching about the subjects directly, and how this has incremented the creativity of the students towards the SDG's implementation ideas.

The aim of the present innovative teaching project is to help students to acquire a deeper knowledge of the syllabus and extra motivation. With the aim of reaching these goals, an educational methodology known as flipped classroom has been proposed to be applied in Foundations of the Masters in Development Practice programme.

Taking as the basis the inverted classroom model, up to 5 activities, individually and in groups, the educational process have been designed with the objective of developing high-order cognitive competences, such as critical or logical thinking.

In order to evaluate the teaching project effectiveness, we will compare the score of the groups within the seminars with the aim of observing if the new educational strategy has had an impact on the results of the whole subject.

Finally, motivation will be evaluated through an anonymous questionnaire, in which the students will be asked about the level of satisfaction of the teaching programme, which activities

they consider more attractive and which aspects they would change in the future.

The results achieved in similar environments show that this can be a solution which involves some extra upfront work and just might not mesh with the teaching style of every educator. But many of the educators that have tried it, found it worthwhile to experiment with flipping some lessons to see what the results are.

### References

1. Thomasian, J. (2012). *Building a science, technology, engineering and math education agenda: an update of state actions*. National Governors Association Center for Best Practices.
2. Khan, S. (2012). *The one world schoolhouse: Education reimaged*. London: Hodder and Stoughton.
3. Davies, R.S., Dean, D.L., Ball, N. (2013). "Flipping the classroom" and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development*. No. 61(4), pp. 563–580.
4. Davies, R.S., West, R.E. (2014). Technology Integration in Schools. In: J.M. Spector, M.D. Merrill, J.Elen, M.J. Bishop (Eds.). *Handbook of Research on Educational Communications and Technology*. New York, NY: Springer New York, pp. 841–853.
5. Talbert, R. (2012). Inverted classroom. *Colleagues*. No. 9 (1, Article 7), pp. 1–2.
6. Wang, S.K., Hsu, H.Y., Reeves, T.C., Coster, D.C. (2014). Professional development to enhance teachers' practices in using information and communication technologies (ICTs) as cognitive tools: Lessons learned from a design-based research study. *Computers and Education*. No. 79, pp. 101–115.
7. Lajoie, S.P., Azevedo, R. (2000). Cognitive tools for medical informatics. In: *Computers as Cognitive Tools II: No More Walls: Theory Change, Paradigm Shifts and Their Influence on the Use of Computers for Instructional Purposes*. Erlbaum Mahwah, NJ, pp. 247–271.
8. Azevedo, R. (2005). Computer Environments as Metacognitive Tools for Enhancing Learning. *Educational Psychologist*. No. 40(4), pp. 193–197.
9. Hsu, H.-Y., Wang, S.-K., Runco, L. (2013). Middle School Science Teachers' Confidence and Pedagogical Practice of New Literacies. *Journal of Science Education and Technology*, No. 22(3), pp. 314–324.
10. Deterding, S., Dixon, D., Khaled, R., Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. In: *Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments – MindTrek'11*, pp. 9–11.
11. Huotari, K., Hamari, J. (2012). Defining gamification. In: *Proceeding of the 16th International Academic MindTrek Conference on – MindTrek'12*, p. 17.
12. Nelson, M.J. (2012). Soviet and American precursors to the gamification of work. In: *Proceeding of the 16th International Academic MindTrek Conference on – MindTrek'12*, p. 23.
13. Fitz-Walter, Z., Tjondronegoro, D., Wyeth, P. (2011). Orientation Passport: using gamification to engage university students. In: *Proceedings of the 23rd Australian Computer-Human Interaction Conference on – OzCHI'11*, pp. 122–125.
14. Brewer, R., Anthony, L., Brown, Q., Irwin, G., Nias, J., Tate, B. (2013). Using Gamification to Motivate Children to Complete Empirical Studies in Lab Environments. In: *Proceedings of the 12th International Conference on Interaction Design and Children*. New York, NY, USA: ACM, pp. 388–391.
15. Flatla, D.R., Gutwin, C., Nacke, L.E., Bateman, S., Mandryk, R.L. (2011). Calibration games: making calibration tasks enjoyable by adding motivating game elements. In: *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology – UIST'11*, pp. 403–412.
16. Iosup, A., Epema, D. (2014). An experience report on using gamification in technical higher education. In: *Proceedings of the 45th ACM Technical Symposium on Computer Science Education – SIGCSE'14*, (2008), pp. 27–32.
17. Pokholkov Y., Zaitseva K. (2017). Specific learning environments for fostering students' sustainability mindset. In: *45th SEFI Annual Conference 2017: Education Excellence for Sustainability: Proceedings*, p. 223–228
18. Quadrado, J.C., Zaitseva, K. Engineering education interdisciplinarity in global teams. In: *45th SEFI Annual Conference 2017: Education Excellence for Sustainability: Proceedings*, pp. 954–961.

*The paper was submitted 23.01.19  
Received after reworking 15.02.19  
Accepted for publication 20.02.19*

Новые педагогические подходы  
для достижения целей устойчивого развития

Квадраду Жозе К. – д-р техн. наук, проф., вице-президент. E-mail: ipp@ipp.pt

Политехнический университет Порту, Порту, Португалия

Адрес: Rua Dr. Roberto Frias 4200-465, Porto, Portugal

Зайцева Ксения Константиновна – доцент, канд. пед. наук. E-mail: kkzaitseva@gmail.com

Томский политехнический университет, Томск, Россия

Адрес: 634050, г. Томск, просп. Ленина, 30

*Аннотация.* В соответствии с принципами компетентностного подхода высокое качество профессиональной подготовки зависит от запланированных результатов обучения, которые студенты должны получить к моменту окончания вуза. Тем не менее определение набора основных компетенций является лишь одним из необходимых, но недостаточным условием для успешного достижения студентами запланированных результатов обучения. В статье рассматривается роль методов преподавания и обучения в разработке и реализации образовательных программ.

*Flipped Learning (Перевернутое обучение) становится общеизвестным педагогическим подходом, при котором прямые контактные методы преподавания последовательно трансформируются из пространства группового обучения в пространство индивидуального обучения, и получающееся в результате обучающее пространство превращается в динамичную, интерактивную среду обучения, где преподаватель направляет студентов, в то время как они применяют концепции на практике и творчески подходят к решению задач дисциплины.*

Для обучения следующего поколения практически подготовленных специалистов, которые будут творчески реализовывать цели устойчивого развития (ЦУР) к 2030 году, необходимо, чтобы преподаватель полностью переосмыслил свою деятельность, нашёл пути, как по-новому подойти к той работе, которую он выполнял определённым образом в течение многих лет. Модель «перевернутого класса» направлена на то, чтобы студенты учились лучше, при этом обеспечивая большую вовлечённость. Дискуссии и практические занятия, как правило, поддерживают интерес студентов. При этом, когда преподаватели проводят контактное обучение, изучая концепции в рамках аудиторного занятия, они могут обеспечить немедленную обратную связь, которая помогает студентам улучшить своё понимание в процессе обучения.

Студенты, использующие креативные подходы в достижении ЦУР в рамках аудиторных занятий, стали больше брать на себя инициативу в поиске ценных ресурсов, при этом продолжая учиться по-своему, используя перевернутое обучение. Этот подход исследует конкретные вызовы в развитии образовательного процесса и его практической реализации.

*Ключевые слова:* устойчивое развитие, перевернутое обучение, вовлечённость, мотивация студентов

*Для цитирования:* Quadrado, J.C., Zaitseva, K.K. New Pedagogical Approaches to Induce Sustainable Development Goals // Высшее образование в России. 2019. Т. 28. № 3. С. 50-56.

DOI: <https://doi.org/10.31992/0869-3617-2019-28-3-50-56>

Статья поступила в редакцию 23.01.19

После доработки 15.02.19

Принята к публикации 20.02.19