

The Integral Class — Effortless Learning and Teaching: Professional Practices

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Abstract: Learning must be, in the early stages of our formation, independent of all social constraints or innate characteristics, being only conditioned by motivation.

Motivating has immense allies, some more obvious than others, but it suffers from two deadly enemies: effort and sacrifice. Both, whatever justification we give, are incomprehensible to young people!

Shift the appeal to self-sacrifice for the development of a system that, in a simple way, creates conditions for learning to be of high standards, but does not require effort from the students, is the proposal of our concept.

If one ask a child or teenager what they like to do the most, we are highly likely to be told that is to play and compete. So, it's up to us, teachers, transform our classes to meet their tastes, knowing that, doing so, our job will also become much more enjoyable and fruitful.

Above all, we will all gain mental readiness and time to debate, reflect and build foundations sufficiently solid so that self-learning and the search for solutions to practical problems becomes effective.

Key words: gamification, meaningful learning, work and personal effort, motivation, role of the teacher

1. Context of Professional Practice

I teach students from middle to high school in an area of my country, Portugal, where there are some socio-economic problems and a great lack of support from families, circumstances that translate into low expectations and some early dropout. Students often have difficulties that come from previous years, motivated by a certain aversion to school that settles in at an early age and they do not normally have study habits or taste for knowledge, which makes demanding the task of involving them in activities. Most of the time, even if there is some desire to change their posture, demotivation quickly sets in and I believe that this results mainly from two factors: 1) the overwhelming workload that comes from facing subjects of more than a dozen disciplines, 2) many teachers persist in a discourse of work and sacrifice that young people cannot understand nor is naturally appealing to them. In my view, it is heartbreaking to see students trying to overcome the overwork situation using the help of parents (who complain, rightly, about the madness of effort that is requested by the school), or paying

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external explanations, or, quite simply, resorting to plagiarism. That result too often in inglorious work, without profit or consequence other than delivering a piece of paper, in a cycle in which, instead of being educated, one is uneducated and nothing is learned.¹

This state of affairs perpetuates, on the other hand, a school that is disconnected from the reality of our times, emphasizing the memorization and pure application of concepts, without a direct connection to the everyday world or any perspective of approaching what is foreseen in “Perfil dos Alunos à Saída da Escolaridade Obrigatória (PASEO)”, a document that outlines the profile that Portuguese compulsory education students should achieve and which was published in 2017 by the Ministry of Education of Portugal.

From the teacher’s point of view, remains the conviction that students have difficulties in school because they work little and have different interests from the scholar affairs, an idea that is reinforced as a result of the routine conversations in the teacher’s rooms and on social networks. It is also an established thought that this lack of work is resolved with more proposed work and punishments, and that interest is reinforced if we diversify the activities separately and without a consistent plan, often subordinating the normal flow of learning, eliminating the time needed for reflection and for consolidation.

The message that all primary and secondary students learn purely by discovery, which has become common in recent years, has also played a role in destroying the chances of recovery for the majority of students for whom this is not true. This notion that one learns consistently and widely investigating, as if students were little scientists, is not compatible with a compulsory education in which it is impossible to realize how could they search for the solution if the overwhelming majority of students are not even encouraged to understand the problem. However, many teachers waste their energy and often miss opportunities to grab students by trying to implement something that often devolves turmoil and very low incomes. But make no mistake, of course students learn better by discovering for themselves. However it is a prerequisite that we are able to grasp them, making them dependent on the act of learning and curious by default.

In short, student’s lack of work is resolved with more work and penalties, and lack of interest is solved with a variety of separate tools, even without coherence or order. All contrary to the most elementary logic. And yet, this is generally how things go: prevails the idea that only effort and personal sacrifice can bring results in a more or less distant future. We adults, because we can already look to the past, have an obligation to realize that none of this is true. As a result of all this, a large part of learning comes down to tasks, which will be well-intentioned, but only reinforce the aversion and reduce the predisposition to learn, contrary to the most elementary intuition that imposes that learning must to be something that is enjoyed and that, in principle, is fluid and does not require sacrifice!

But there is even more.

By diversifying their activities separately, flooding students with work and tasks, teachers create a skein that 1) presents risks of loss of quality control, 2) requires a lot of production effort and 3) causes anguish for often suffering from lack of validity. In the end, there are still the tasks of correction and evaluation of the work that (for those who have hundreds of students) end up consuming so much time that deplete the capacity for mobilization and often throw teaching into the background, with the fact that assessments ends up resulting only in a tool of penalty and pressure, without any pedagogical benefit.

¹ My father didn’t study after primary school because his teacher demanded too much homework and then beat him when he didn’t know the subjects. That’s why he and his classmates ran away from school and didn’t even want to hear about it! 60 years later, we got rid of the beating, but we still can’t eliminate the effort and work!

We can summarize this learning methodology with the very same scheme that would have been used 50 or 100 years ago:

School: Lectures + experimental classes with application of an experimental protocol + example exercises (active teachers and passive students);

Home: Study with summaries and memorization of concepts + consolidation exercises + experimental activity reports + intensive preparation for national exams with further explanation and resolution of them + various assignments.

This way of proceed is maintained, even with the modern tools that the Internet has made available, as it is considered that there is no alternative. It proposes a teaching that does not encourage the understanding of the subjects and the creation of interconnections that allow for a comprehensive knowledge, at the same time that it falsifies the very essence of what Education is, by privileging study strategies for assessments purposes and the resolution of exam-type problems.

And yet, it is now easy to do differently, and develop solutions that:

- eliminate, for both teachers and students, the weight of the words “effort” and “sacrifice”;
- are simple, intuitive, direct, efficient and standardized, so as to guarantee a way of proceeding that everyone knows and feels comfortable with;
- ensure not only very high standards of learning, but also global training;
- it very quickly creates a theoretical knowledge base that makes self-learning and inquiry possible.
- encourage a scientific, proactive and very serious attitude in approaching problems and seeking solutions.

If we do this, we really bring students into the school and win them over to knowledge, creating the basic conditions to build a globalizing education and developing in the students such an investigative spirit that will enable them to learn on their own, experimenting or deducing.

2. Brief Explanation of the Portuguese Education System in Order To Understand the Evaluation of Our Concept

Portuguese compulsory education comprises 12 years of schooling. Elementary school starts at 6 years of age and it takes 4 years, middle school goes from the 5th to the 9th grade and secondary education consists of the 10th, 11th and 12th grades.

My subject includes Physics and Chemistry in one class, it starts in the 7th and goes up to the 11th year, and in the 12th year there is a division into two separate subjects: Physics and Chemistry.

The academic year is divided into 3 academic periods: the 1st until Christmas, the 2nd from Christmas until Easter and the 3rd until June.

The learning assessment system is made up of a variety of parameters ranging from written tests to laboratory work and attitudes and, typically, each of the parameters is evaluated in percentage. At the end of each academic period there is a summative evaluation of each student that summarizes the work done in the academic year up to that moment. This evaluation results in a final grade, which corresponds to an integer, ranging from 1 (poor) to 5 (excellent) in middle school, with grades 4 and 5 considered very successful results, and 1 (poor) to 20 (superb) in high school, with grades equal or above 16 considered very successful results. In middle school, if a student has 1 or 2, it is considered that they have not attained the minimum learning requirements and, if this happens in several subjects, the student may even be retained in the same year of schooling. Exactly the same

happens in high school for grades below 10.

At the end of the 11th year, Science and Technology students have to take national exam of Physics and Chemistry evaluating all subjects worked on in the 10th and 11th years whose grade (from 0 to 20) directly counts towards their final assessment and for the university entrance graduation.

3. Report of My Professional Practice — The Integral Class

There is something distressing when we think that, in all professions, we have already managed to get technology (computers, robotics, etc.) to put an end to the hard and menial work of the past, but we have not yet advanced down that path in our schools. Why do we continue to ask our children for effort and sacrifice in order to have a more comfortable life when they are adults, knowing that they can have a comfortable life from the beginning?! Why are we so obsessed with the need for pain as an essential condition for success?! Why do we say “no pain no gain” when we know perfectly well that this is not always true and most things that are worthwhile in this world are achieved with motivation and persistence, but not with an attitude of forcing our bodies and ours intellect?!

These thoughts and my experience of direct contact with more than 3000 students over more than 20 years led me to create, in 2017, the teaching-learning concept The Integral Class – Effortless Learning and Teaching (from now on referred to only as The Integral Class), a concept that earned me the nomination as one of the 10 finalists of the Global Teacher Prize Portugal, in 2019.



Figure 1 The English Version of Our Logo Which Is Part of a Deliberate Strategy to Make the Concept as Serious as Possible in the Eyes of Students

I called the concept The Integral Class with a double meaning in mind: I want global learning, which integrate a great diversity of subjects, but which is, at the same time, a healthy proposal for teachers and students, to eliminate low-performance procedures and transform the school into a place where learning is enjoyed (in Portuguese, the word *Integral* can refer to healthier whole food).

The Integral Class creates multidisciplinary and carefree learning scenarios in which the developed activities no longer carry the burden, often harmful, of assessment. The student ceases to carry out work because he is being assessed, to become involved in purely discovery and learning projects in which he feels motivated to participate in order to learn and, with this, improve results in a snowball-like effect. This becomes possible if we have a standardized system that works in a continuous consolidation of learning.

The Integral Class student learns and consolidates daily in games (elements such as quizzes, missions, escape rooms + league table) which present results in real time in a system that has a strong competitive and playful component, ensuring at the same time that each one of them absolutely controls their own learning. Moreover,

families and guardians also have daily, simple and direct information on the learning of their students and have the possibility to intervene. They can, for example, freely decide whether they want to participate in activities alone, with help, with a tutor, or if they feel it is a good idea for someone to replace them. It is a free choice and, in that sense, it is also a learning experience. Of course, the system has control mechanisms, and the very dynamics of the entire process strongly discourage fraud or shortcuts: we can distort our performance by 1, 2, 3, a dozen times, but it will be embarrassing to do it by the hundreds at the rate 2 or 3 per week. In the end, the entire assessment and, consequently, the learning itself is built by the student, with minimal teacher intervention.

We can say, briefly, that The Integral Class is a pedagogical concept that aims to end the boring part of the teaching-learning process. There are not:

- old-fashioned study;
- subjects to memorize;
- prepare tests and exams;
- extra-class explanations.

The student is responsible for their learning and, at the base, they only play, trying to be more and more efficient, being essential for this to be attentive in classes and acquire knowledge; the teacher is responsible for encouraging the student to play and for taking pedagogical advantage of their achievements. It's not a technology class; is a concept that takes advantage of technology in educational game environments that provide any kind of final rating or accuracy measure, such as Kahoot!, Quizizz, Mentimeter, Quizlet and others.

In The Integral Class, the learning methodology is based on the following scheme:

Theoretical, experimental or field classes + games + self evaluation + league table

The goal is, as the name implies, to learn and teach effortlessly. Effort here should be understood as something we are compelled to do, but we don't want to do at all. What Integral Class does is to turn the school into an environment of permanent challenge, focused on self-learning and responsibility, in a playful but demanding way that the teacher can continuously control.

The teacher uses only simple, intuitive and very straightforward tools and always uses them in a standardized and predictable way. You can play individual or group games, in the classroom or at home, not having to spend energy with the assessment, but only with the creation of activities (which can be done in groups, for example, in interdisciplinary activities, or in the class). There are even games that are made by the students themselves. For instance, from an online form, each one of them creates a question and formulates the respective answer, being the compilation done automatically to create a quiz.

In The Integral Class there is no limit to the number of attempts students have to complete the activities (we emphasize a responsible way of doing things “fake it till you make it”), always counting the best grade obtained, a fact that encourages the search for knowledge and the authenticity of the obtained result: it is essential to value the error because only from it do truly significant learnings result, at the same time that we must do everything to dissuade non-participation. The game can be opened as often as we understand and repeated in multiple ways, so that no subject is forgotten because others have overlapped: learning is truly interconnected and not just subjects that fall in turn. In this way, students can learn on their own, playing and using the tools they are most familiar with, the computer or mobile phone. They can share knowledge, search freely, raise doubts and exchange views. And, above all, they can fight for knowledge, in a self-learning movement, which results in great pleasure and the least possible sacrifice and effort (and, by the way, the expenditure of a fraction of the time of so-called classic activities).



Figure 2 Me in Classes With My Students in the Middle of a Tournament!

Of course, using electronic quizzes in class is nothing new and, as we said, there are multiple applications that we can use for this purpose. In fact, if we only have quizzes or even other type of games, the only thing we're doing is replacing paper exercise sheets with electronic ones: very little new and certainly not game-changing. What truly makes us proud of the concept we created and we think it's worth sharing is the gamification system.

As we recognize that real-time, reliable, systematic and formative information for students is an extremely important factor for the motivation of each one, we developed a computer tool in a spreadsheet which, through a macro automatically sends information on a weekly basis to each student's email about the assessment of different parameters and the global final average, with indication of ascents and descents. The content of this message is as follows:

"Hello... (student's name)

We update your assessment of the Physical & Chemistry course on March 24th.

Your current grade on the attitudes component is 90% and is stable in relation to the latest information!

Your current average is 93.7%, while your class average is 87.2%!

You have to take every opportunity so that the average can go up!

If nothing else changes, your average will:

- increase to 93.7% if you get 100% in the next activity of Aula Integral.

- devalue to at least 88.1% if you don't participate in the next activity of Integral Class!

Right now, your average is 11th best out of a pool of 79 7th graders, and you're 0.3 percentage points off the top spot!

The teacher,

Warnings:

Indicative information.

Values subject to daily change!

Keep in mind that the School is a place of cooperation, not competition. In this sense, all the information contained in this message should be understood as an incentive to overcome yourself, collaborating more with your colleagues.

Any complaint may imply descent in the "Attitudes" component!"

All the data relating to evaluation is collected from the assessment information application we use to the spreadsheet, that is linked to a form where the students themselves insert the grades they obtain. The spreadsheet then generates a leaderboard (league table) that is published in real-time to the learning management system (LMS)

we use.

We have permanently set up game tournaments, each one has a maximum of 10 rounds (that is, for example, 10 electronic quizzes), thus preventing the students who start with more difficulties from becoming disinterested. Throughout the school year, tournaments are successive, there are often review days, so that the knowledge already acquired is significant and always contributes to new learning.

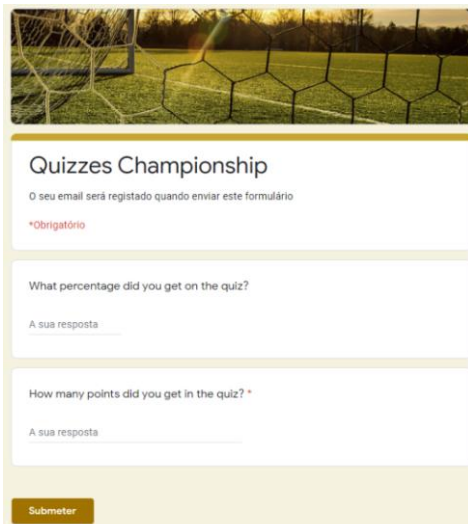
There is a system of bonuses, prizes and badges for goals, but no penalty is foreseen for those who do not participate. And you know what: in hundreds of students I don't have anyone who doesn't participate. In the end, we have had students truly involved in all activities, in order to learn more to get better results in electronic quizzes and climb the performance leaderboards.

Briefly, The Integral Class has 4 components:

- Communication through a learning management system (LMS), such as Google Classroom or Microsoft Teams;
- Intensive gaming (gamification);
- Real-time information.
- Advanced laboratory and field experimentation.

We can summarize the procedures as follows:

- the teacher addresses the essential content provided in classes or electronically (or encourages research), in short periods, which ensure the concentration of students (generally, no more than 45');
- all the consolidation is in charge of each student in electronic quizzes that can be solved on the mobile phone or on the computer right away in class, individually or in groups, or at home, maintaining a permanent connection with each other (we use mainly Kahoot! and Quizizz, but there are plenty of platform with self evaluation and accuracy systems that can be used according to the needs of each subject;
- students input their own results on the purpose-built form (Figure 3), which in turn generates a leaderboard for each tournament that is updated in real-time in the LMS (Figure 4). There is, therefore, an environment of healthy competition that generates a highly motivated movement and develops the need to participate (if we want to use language that students understand, we create FOMO — fear of missing out).



The image shows a web form titled "Quizzes Championship". At the top, there is a header image of a soccer field with a goal. Below the title, there is a note: "O seu email será registado quando enviar este formulário" and a red asterisk indicating a required field: "*Obrigatório". The form contains two text input fields. The first is labeled "What percentage did you get on the quiz?" and the second is labeled "How many points did you get in the quiz? *". Both fields have "A sua resposta" as a placeholder. At the bottom of the form is a yellow "Submitter" button.

Figure 3 The Form We Use for Students to Input the Results They Get in the Electronic Quizzes




Posição	Name	Class	Av. (%)	1ª Jornada	2ª Jornada	3ª Jornada	4ª Jornada	5ª Jornada	6ª Jornada	7ª Jornada	8ª Jornada	9ª Jornada	10ª Jornada	Total
	Manuel Silva	B	49,0	80 000	45 678	87 654	76 543	50 000	10 000	12 349				362 224
	Paula Machado	C	56,2	23 456	98 325	89 111	34 523	45 678	45 678					336 771
	David Ferreira	A	37,3	20 000	25 000	22 233	21 355	12 354	23 000	36 474	65 432			225 848

Figure 4 The Quiz Championship Leaderboard Which Is Updated in Real Time in Our LMS

- in the laboratory, the practical application of the concepts is carried out and their validation through experience, resorting whenever possible to data collection and processing technology;
- there is a systematic control of the learning pace by the teacher who makes an assessment in real time and uses a system of bonuses and incentives that prevent alienation.

There are hundreds of electronic quizzes and thousands of questions, and the massification strategy also aims to place students in a situation where the tension of not participating becomes unbearable and forces them to get involved. In total, each school year, there are more than a million responses to questions.

Working with the electronic quizzes ended up resulting in a website where we share them with all colleagues and their students². With this, we have created a product that, we believe, can help a lot to improve our education system.

Above all, with the work carried out in this way, it is possible to strongly reinforce the laboratory component of the classes, carrying out activities that are not provided for in the curricula and integrated with other disciplines and domains. Once the basic concepts are acquired, we can effectively learn through discovery, understanding the problems, in a systematic search for answers that constitute new learning. As we emphasize in before, it is only possible to learn through research if we understand the problems and we understand the problems only if we acquire solid basic knowledge.

3. Discussion and Evaluation of the Implementation of The Integral Class

With The Integral Class we reached 3 very important targets for the cause of Engineering and Science students:

- In the words of the students themselves, we have made scientific subjects “surprisingly simple”, as everyone who participates in the activities obtains excellent academic results, with very little personal effort (unless gaming is considered an effort), while all indiscipline and school dropout was eliminated, creating a product that can be easily applied to all students. We no longer have students who, having a personal taste for scientific areas, report that they will have to go into other areas because they do not feel capable of dealing with the difficulties.
- A significant part of learning is self-learning, with a lot of responsibility and incentives for creativity. In this way, arise conditions so that a civic conscience and a scientific attitude can be born and grow, which later leads to an attitude of value creation and entrepreneurship;
- We have provided all students with basic conditions so that they can think about concrete problems with tools that put them in a position to find answers. With much less time spent on theoretical concepts,

² <https://www.aaulaintegral.pt>.

eliminating the effort to consolidate them, much more remains to reflect and act on more concrete problems and to value practical and experimental activity.

With regard to school results, it is important to recognize that, at the limit, there will always be students who, no matter what we do, simply don't want anything to do with the school and end up having to take alternative school paths. However, it is impressive how the overwhelming dynamics of Integral Class ends up reducing these situations to a minimum, making them practically residual.

On the other hand, it is never too much to remember that School is not just about results and averages, but about learning, ways of being, sensitivities, persistence, self-control, patience and countless other human characteristics that are worked on, but it is not possible quantify. Even so, from the what we can quantify, that is, the grades that correspond as best as possible to acquired knowledge of subjects that specifically concern the school subject, we leave a synthesis in the graphs that follow.

It is interesting to compare the average values of the grades before we had applied The Integral Class (before 2017) and after having started this implementation.

In Figure 5, we have an average value of the grades we obtained for students in middle school before 2017.



Figure 5 Average Grades, for Middle School, Before We Implemented the Integral Class

The following graphs summarize the final levels in 2017/2018 (71 students), 2018/2019 (68 students) and 2019/2020 (147 students) school years:

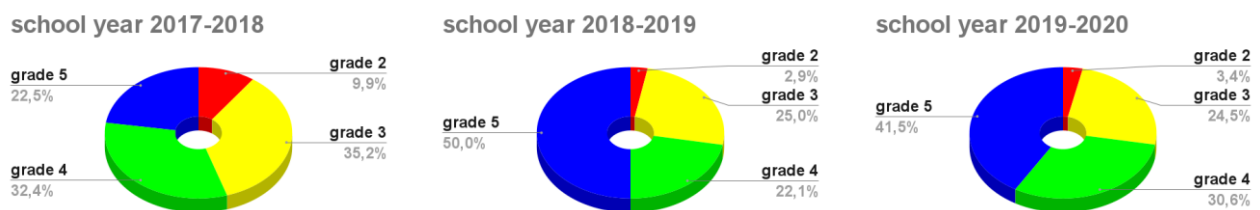


Figure 6 Grades Obtained by Students of Integral Class of Middle School in the Last 3 Academic Years

There is, in fact, a great improvement, not only with the reduction of grades that reveal difficulties, but especially with a large increase in very successful results (grades of 4 and 5).

As for high school, 11th grade, I had 23 students in the 2017-2018 school year, 52 students in the following year and 28 students in the school year that ended in 2020. The distribution of grades for these students is detailed in the following graphs (Figure 7):

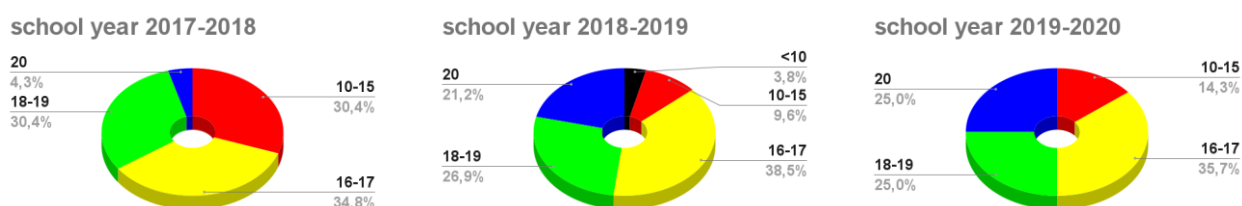


Figure 7 Final Classifications Obtained by Students From Integral Class in High School

In the 2018-2019 academic year alone, we had two students who were unable to obtain a grade that would guarantee their approval (equal to or greater than 10). Moreover, the vast majority of The Integral Class students obtained very high quality results, which allowed them, in most cases, to follow a first-choice higher education degree and be able to overcome any type of learning difficulty that might arise in the future.

In order to have a comparison, we will see the same results for the 2014 to 2017 school years (30, 54 and 47 students, respectively), before the start of The Integral Class (Figure 8):

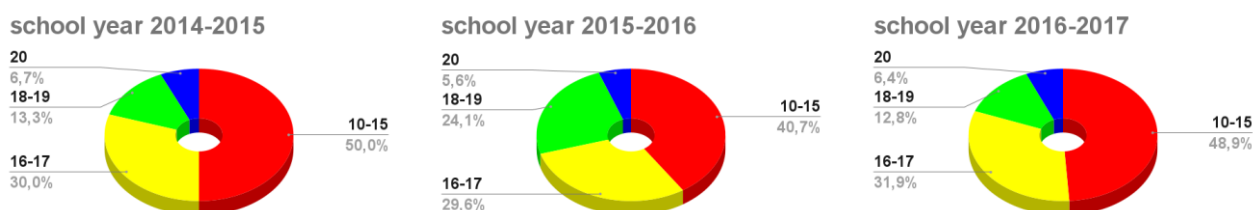


Figure 8 Final Classifications Obtained by Students of High School Before the Integral Class

As I mentioned before, at the end of the 11th year, Portuguese students are subject to a national exam that includes, in the case of Physics & Chemistry, subjects worked in two academic years. It is a very demanding 120 minutes written examination that has a significant weight in the conclusion of high school. For most higher education courses in engineering and science an exam grade equal to or greater than 10 is required and for medical school the minimum is 14. Usually, there is a difference of about 4 values between the grade that students get in classes and the grades they obtain in the national exam (with a disadvantage for this one) because, while the laboratory component of the subject is valued in classes with a positive impact, the national exam is purely theoretical.

The following chart (Figure 9) shows the averages of the scores on the national exam of The Integral Class students and the averages of these scores at the national level.

In 2018, about a third of students fulfilled the requirements to be able to apply for a medical school, in 2019 this number rose to 35% and, last year, we had 60% of students with an exam grade equal to or greater than 14 points. In the accumulated result for these 3 years, only 10 students failed, in their first attempt, in the national exam, obtaining a result lower than 10 (the system allows them to repeat the exam and succeed afterwards). We must not forget that many students who stay at the doors of colleges and do not enter higher engineering or science courses, do not do so because of lack of taste or aptitude, but because they choose other areas at the end of the 9th year (frightened by Physics and Chemistry and Mathematics) or, having chosen Sciences and Technologies, they end up not meeting the conditions of entry because they obtain below the minimum grades in the national exams. In 2020, 23.8% of students who took the exam were unable to obtain a grade of 10 or more and are

therefore automatically excluded from applying for engineering and science College Education (unless they succeed in the next opportunity). At the same time, all The Integral Class students were successful in achieving that goal.

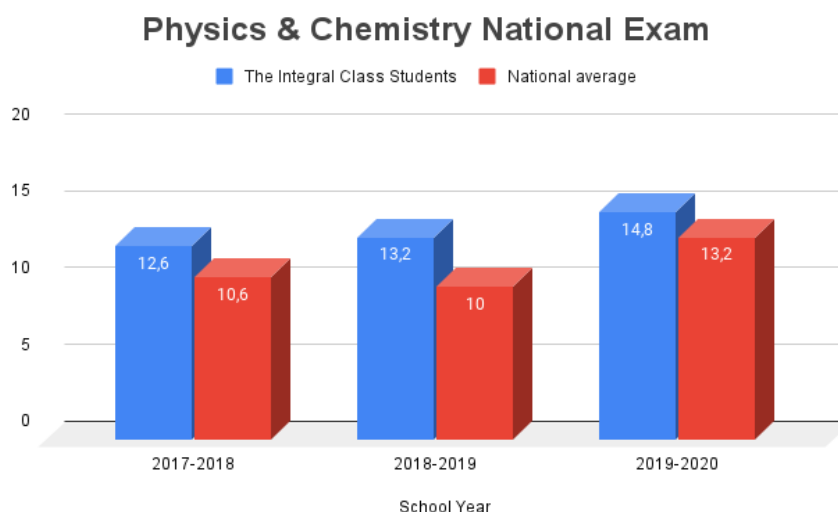


Figure 9 Comparison of the Averages Grades of National Exams Between the Integral Class Students and the Result at National Level

An added, last-minute advantage of our system came when the school had to be closed due to the COVID-19 outbreak. The students of The Integral Class continued with their learning in a perfectly normal way, even from home, interacting with the teacher as usual, being possible to teach the subjects with quality and in a global way in synchronous and asynchronous activities that they were already doing. In fact, there was a huge demand for our concept of teaching and learning experimental sciences, with visits to the blog increasing enormously, and a very expressive increase in the use of these tools (it should be said that, throughout the school year, we streamlined various short-term actions on The Integral Class). Even the only new element that we introduced, and which allowed classes in videoconference, was welcomed by the students in a very natural way, used to the entire technological environment of the discipline.

4. The Word of Students and Difficulties of the Concept

At the end of each term we implement a student survey to assess the concept and try to understand how we can improve. Students can also freely and anonymously leave their opinions on the subjects. Strangely, the only bad reviews I get are always asking for more: “more games”, “more electronic quizzes”, “more activities”! On the other hand, I receive messages of enormous encouragement and that they are what is best in our profession. I take the liberty of sharing some in this paper:

I have nothing to point out other than to thank you for your futuristic thinking and for your way to manage to save time for the students, to be able to encourage them and, at the same time, to work and learn much more. Much Thanks

Praise your work throughout the year. Got excellently shape our mindset so that everything went well. I actually feel I learned more with you than with the last four years I already had had the discipline.

There’s nothing to point out, I really enjoyed the way this was given to us. Also, I think it is important to give due value to quizizz, since these helped a lot in the study.

I really liked your simple and straightforward way of teaching and the method used (games) to consolidate the that we have

learned, although at times I think that the number of electronic quizzes exceeded in relation to the time that we had.

I honestly liked it a lot. All framing that makes the matter a lot easier, plus manages to make classes lighter. An excellent teacher, keep up the good work.

Nothing to point, everything super organized and ready to obtaining the best possible results.

I really enjoyed your work as a teacher and I admire you a lot.

I love Mr. D. Ferreira's classes, that's why even though it's my favorite subject!

I really like this discipline and I don't think we have nothing to improve I think it's already great!

I don't have any suggestions since our teacher is very committed and creative in the method of teaching that develops with us. Thanks.

I have no criticisms to make. Classes are great as they are!

I was always a student who didn't have many study habits, couldn't get home and start studying right away, I always ended up procrastinating. However, with his games method, everything was different, I did them all since the beginning of the year and without much effort I managed to get 20 at the end of the year and 20 on the national exam. I probably couldn't get results like these with another method. This only demonstrates your vocation and excellence in the field of education.

Of course, not everything is perfect and it is clear that we are still at the beginning of a journey that will have great evolution in the near future.

From the outset, we have a concept that eliminates effort, but does not eliminate the need for work and application. What we do is try to meet, as much as possible, what young people like, eliminating what they don't like to do and replacing it with what gives them pleasure. The price to be paid is the transfer of greater responsibility to the students themselves with the existence of much more frequent activities. There may be situations in which students feel a little more stressed and complain about being over-active. The next complaint was the only one we received and came from a class with excellent students who, in fact, had achieved such a high level of performance that perhaps they did not need such frequent activities:

Students have to point out that there is an exaggeration in the number activities to do outside of class in the Physics & Chemistry subject, and we think that the amount of these should be shorter and the deadline should be longer. Students would also like the computer exercises of the Physics & Chemistry discipline did not have such short deadlines in assessment times, and instead were available in the days before the tests of this same discipline to be able to take more advantage of them.

Anyone who has experience in Education knows that it is very difficult to create solutions that serve all the students that make up a class, and it is even more difficult to create specific solutions for each student when we often serve hundreds of students. The best solution to this problem, I think, lies in simplifying: the method we adopt has to be simple and easily adaptable. In The Integral Class we have a method that goes to the base of the problem, which uses very simple tools and which is adaptable (we can create diversified incentives, increase or reduce activities individually, reinforce very specific aspects, give bonuses, etc.). But even so, it is always possible that we have students who are not receptive to the proposal we have for them, so we will never be able to say that the concept solves all our problems, although, seen in perspective and comparing with other proposals, we are firmly convinced that The Integral Class has a very high learning/effort ratio.

To be really effective, the concept requires very frequent games, and while each game typically doesn't take more than 10 minutes, paradoxically, there is a risk that we might create situations where students feel overwhelmed. It is a management that is not easy to do, because we will always have students who want more and more, and alongside others who need more time to assimilate. This is true for any consolidation activity that we undertake, but it is easy to see that when we have so many proposals, the risk ends up going up a lot.

Another problem that can be pointed out has to do with the competitive factor. The Integral Class has an

important competitive load, as we had the opportunity to describe. Since most students will be interested in this very direct incentive, it is still true that there are risks that some students may feel discomfort and, in extreme situations, some sensitivities may be negatively affected. It is necessary for the teacher to use common sense and adapt the concept to the students he is dealing with. For example, by default, the leaderboard, which is published in the LMS, only includes the TOP10, so that no student feels underestimated (each student receives, via email, as we have seen, information about their position at each moment, but such is not made public). On the other hand, advantageous conditions are created for students who are having more difficulties, for example, reducing in these cases the number of questions that the electronic quizzes have. These are all strategies to minimize a problem that is real and of which we are very aware.

It is also true that we deal with the problem of managing individual freedom. In The Integral Class, all students are free to participate in the games as they want. Ultimately, we can have students who copy everything or who get someone to play in their turn. It is a freedom assumed and the system is just like that, with parents being informed that this possibility exists and even encouraged to help their children. Of course, this can create situations in which more compliant students feel wronged and may be discouraged. The solution is to create games that take place in the classroom in a controlled environment, taking care, for example, to control communication with the outside world, or to diversify with other types of activities that can serve as validation (call to the board, oral evaluation, troubleshooting, etc.).

Another issue that we need to be aware of is the use of bots, widely available on several websites. These bots solve electronic quizzes automatically without student intervention and are very difficult to detect. Again, it is necessary to create a validation system, for example, using games where there are false corrects that the bot marks as the right answer, despite being blatantly wrong and thus detecting that there was no student intervention in the choice. Ultimately, electronic quizzes platforms such as Kahoot! or Quizizz have the possibility of internally detecting the use of bots, simply by having the teacher ask them this question.

On the teacher side the first difficulty that comes to us has to do with the work needed to assemble the concept. It's just that to say that The Integral Class is a solution for effortless teaching is true only once we have the entire system assembled. Developing games from scratch in a way that satisfies us and fits our way of being and teaching is a very demanding process, even from a physical point of view, and it takes a lot of time. This does not even mention the fact of opting for innovative tools, which will require us to be creative, it's hard to explain at a time when textbook publishers provide countless preconceived materials that we can use directly. There is a psychological weight that is not negligible in our option.

However, this initial workload is offset by much greater personal fulfillment (hence "effortless") and can be greatly minimized if there is sharing between colleagues. If everyone collaborates in the preparation of the tools and then shares them, we will very quickly reach a situation where the work place is fluid and very comprehensive. This, of course, has the advantage of massifying the way we act and give equal opportunities to more and more students. From the teacher's point of view, this would bring the enormous advantage of creating databases of electronic quizzes that everyone could use, distributing tasks and leaving free time for permanent investment in innovation. Ultimately, we would be able to create a common school-wide process that would be known by the school where students truly and effortlessly learn (just by playing). It should be noted that the original project of The Integral Class is to transform it into a so called Domain of Curriculum Autonomy (DAC), in which students use the same consolidation and assessment tools in the different subjects, in a standardized and consistent way, since the concept, being generic and flexible, can be applied with all the specific adaptations that the

circumstances require.

It is with this objective that I have been involved in immense dissemination and training actions with my fellow colleagues, who, fortunately, have shown great interest and enthusiastically adhered to these initiatives. In the 2019-2020 school year, almost two hundred teachers participated in training actions on The Integral Class that I promoted in schools in my region. I have also been active on social media, creating dissemination tutorials and sharing the different activities that we are implementing. Dissemination articles, such as this one, have also been published on websites related to Education in Portugal.

Of course, as always in innovation, we encounter a lot of hesitation and it's normal that there is resistance to experiment. It has not been easy to make this application more widespread, but, interestingly, with the confinement due to the Covid-19 outbreak, the landscape has changed and there is much more interest in alternative concepts to traditional teaching, so we maintain the expectation that we can actually make progress towards teaching-learning concepts (such as The Integral Class) that are not so demanding for students and put an end to the aversion that many feel for the classroom and for studying. After all, learning cannot be a sacrifice!

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References

- Ministério da educação (2017). *Perfil dos Alunos à Saída da Escolaridade Obrigatória (PASEO)*, Lisboa (ME).
- Araújo I. and Carvalho A. (2014). "Gamificação: uma oportunidade para envolver alunos na aprendizagem", *Atas do 2.º Encontro sobre Jogos e Mobile Learning*. Braga: CIEd.
- Oliveira H. (2017). "Olhares sobre a escola: Perceções e expectativas de alunos e encarregados de educação", Dissertação de Mestrado em Administração e Gestão Educacional. Univ. Aberta.
- Bergmann J. (2019). *Sala de Aula Invertida: Uma Metodologia Ativa de Aprendizagem* (1 ed), São Paulo: LTC.
- Morán J. (2015). "Mudando a educação com metodologias ativas", in: C. A. Souza & O. E. T. Morales (orgs.), *Coleção Mídias Contemporâneas: Convergências Midiáticas, Educação e Cidadania: Aproximações Jovens*, Vol. II.
- Vaz R. F. N. and Nasser L. (2019). "Em busca de uma avaliação mais justa", *Com a Palavra o Professor, Vitória da Conquista (BA)*, Vol. 4, No. 10.
- Cohen A. and Fradique J. (2018). *Guia da Autonomia e Flexibilidade Curricular*, Lisboa: Raíz Editora.
- Esteves M., Veiga N., Monteiro R. V., Pereira Â. and Veiga A. (2018). "Kahoot! Em sala de aula. Um caso de estudo", in: D. Alves, H. Pinto, I. Dias, M. Abreu, & R. Muñoz (Orgs), *Livro de Atas da VII Conferência Internacional Investigação, Práticas e Contextos em Educação*, Leiria: Instituto Politécnico de Leiria, pp. 236- 237.
- Panadero E. and Alonso-Tapia J. (2014). "How do students self-regulate? Review of Zimmerman's cyclical model of self-regulated learning", *Anales de Psicología/Annals of Psychology*, Vol. 30, No. 2.

- European Schoolnet (2018). “Science, technology, engineering and mathematics education policies in Europe”, Scientix Observatory report. October 2018, European Schoolnet, Brussels.
- Hake R. R. (1998). “Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses”, *American Journal of Physics*.
- Clapp E. P., Ross J., Ryan J. O. and Tishman S. (2017). *Maker-Centered Learning, Empowering Young People to Shape Their Worlds*, Jossey-Bass.
- Ritchart R., Church M. and Morrison K. (2011). *Making Thinking Visible: How to Promote Engagement, Understanding, and Independence for All Learners*, Jossey-Bass.
- Alves L. (2009). “Estratégia de jogos na EAD”, in: F. Litto & M. Formiga (Eds.), *Educação a Distância: O Estado da Arte*, São Paulo: Pearson Education do Brasil.
- Rita G. (2019). “Challenges of education for the 21st century”, *Journal of Modern Education Review*.
- Arnold B. (2014). “Gamification in education”, *Annual Conference of American Society of Business and Behavioral Sciences (ASBBS)*, Las Vegas, NV.
- Lopes R. (2014). “Gamification as a learning tool”, Polytechnic Institute of Bragança, Bragança, Portugal, core.ac.uk.
- Antonacci A. et al. (n.d.). “The effects of gamification in online learning environments: A systematic literature review”, Welten Institute, Research Centre for Learning, Teaching and Technology, Open University of The Netherlands.
- Herrewijn J. (2018). “Applying gamification in higher education as a method to develop the 21st century skills: A literature review”, available online at: <http://www.avansacademie.nl>.
- Lombardi M. M. (2007). “Authentic learning for the 21st century: An overview. Educause learning initiative” (Eli paper 1).