Motivation and inclusion: Actions Towards the Goal of Reducing Dropout Rates in Brazilian Schools

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Abstract

The school dropout represents a global issue that emerges from different sources and causes. The lack of motivation as well as the low levels of inclusion of people with special needs are among them and have received a great deal of attention in designing strategies and actions for reducing the dropout and increasing retention rates. In Brazilian vocational, scientific, and technological education these rates are still high, representing a great matter of concern. So much that the Brazilian Ministry of Education has recently established guidelines to overcome them. In this context, and taking those guidelines into account, a huge quantity of studies, strategies, and techniques can be found, aiming to contribute to the cause. This article presents some approaches that were applied in three different campuses of Federal Institute of Education, Science, and Technology of São Paulo involving: the robotics as pedagogical tool; a strategy for deaf students inclusion; and a multidisciplinary Project-Based Learning application that addresses productive sector needs. Interesting results were observed pointing out that the applied approaches represent feasible and promising ways of dealing with the presented concerns.

Resumo

A evasão escolar representa um problema de ordem global que surge a partir de diferentes origens e causas. A falta de motivação e os baixos níveis de inclusão de pessoas com necessidades especiais estão entre elas e têm recebido atenção em estratégias e ações para a redução das taxas de evasão e retenção. Na educação profissional, científica e tecnológica brasileira estas taxas permanecem elevadas, representando um grande ponto de preocupação. Tanto que o Ministério da Educação definiu, recentemente, orientações para superá-las. Neste contexto, bem como considerando aquelas orientações, uma grande quantidade de estudos, estratégias e técnicas podem ser observadas no sentido de contribuir com a causa. Este artigo apresenta algumas abordagens que foram aplicadas em três diferentes câmpus do Instituto Federal de Educação, Ciência e Tecnologia de São Paulo, envolvendo: a

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robótica como ferramenta pedagógica; uma estratégia para a inclusão de alunos com deficiência auditiva; e uma aplicação multidisciplinar de Aprendizagem Baseada em Projetos considerando necessidades do setor produtivo. Resultados interessantes foram obtidos, indicando que as abordagens aplicadas representam caminhos viáveis e promissores para lidar com as preocupações apresentadas.

1. Introduction

As stated by Edwards (n.d.), the school dropout issue is global. Many of the challenges around completing school are almost the same, varying only in scope and depth of the problem.

In response to this issue, governments in different countries, including Brazil, are defining and implementing policies to increase rates of courses completion and dropout rates reduction, mainly at the secondary school level (Lamb, Markussen, Teese, Sandberg, & Polesel, 2010).

Idoeta (2014) states that in Brazilian high schools it is common to find out discouraged teenagers, lots of them lagging behind. There is also an extensive curriculum generally unconnected with the reality and the students' needs, and full of theoretical lectures, unable to address some students' previous shortcomings. Besides that, it is possible to realize an absence or low levels of inclusion in schools. This fact contributes to people with disabilities either dropping out of courses or not even attempting to start them.

The Brazilian Federal Network for Professional, Scientific, and Technological Education (BFNPSTE) is a huge group of public schools that offers courses mainly at the High School level. It also acts offering professional and basic education, taking into account: youth and adult education; teacher training; bachelor and technological degrees education; and posgraduate programs.

By realizing the increase of dropout and decrease of retention rates in BFNPSTE, the Brazilian Federal Accountability Office (BFAO) requested the Brazilian Ministry of Education to study this issue, and to elaborate the guidelines to overcome it (Brasil - MINISTÉRIO DE EDUCAÇÃO, 2014).

Therefore, taking into account those guidelines and some successful experiences in Finnish education system, this paper presents some initiatives that can contribute to the reduction of the dropout rates at the BFNPSTE. In particular, it highlights some actions that might promote students success.

2. The dropout and retention issues in Brazilian Federal Institutes of Education, Science and Technology

Although it is unquestionable that the vocational courses offered by the BFNPSTE are very relevant for the country's development and that they are critical to the reduction of social inequality, since they contribute to Brazil's productivity and sustainable economic growth (Brasil – Tribunal de Contas da União, 2012), the schools that offer these courses are still facing serious structural problems that may impair their capacity to stay on a path of continuous growth. They had also encountered a hard time in providing a sufficient quality standard and efficiency, mostly because of the high dropout and failure rates, despite the fact of they have been keeping a high level of scientific and technical competence.

Unfortunately, this problem does not only concern the BFNPSTE but also other Brazilian traditional educational institutes, especially during the early years of the courses. For example, according to the Undergraduate Pro-Rectory at the University of São Paulo, one of the oldest university in Brazil and one of the most prestigious higher education and research institutions in Latin America ranked among the top 70 universities in the world, some courses have averages of about 34 % for dropout rates and 16 % for failure rates (Universidade de São Paulo, 2014).

Beside this scenario of high failure and lower efficiency rates, there are others factors that put some barriers to the development of educational sectors. It is possible to highlight some distance between the curriculum and the real needs of the labour market and students, especially when it is considered vocational education.

Aiming to tackle those problems, the Brazilian National Education Plan (NEP) – from Portuguese "Plano Nacional de Educação – PNE" (BRASIL, 2014) has been in effect since 2014. According to this law, over the next 10 years, it is expected that the enrolment in vocational schools will triple, while ensuring the quality and enabling that at least 50 % of the students are in public schools. Moreover, it is necessary to increase gradually the completion rates for vocational courses in BFNPSTE to 90 %.

Besides that, the Agreed Targets and Commitments (ATC) were established and regulated in 2010 by a set of agreements between the Brazilian Ministry of the Education and Culture and each Federal Institute in BFNPSTE. This ATC is composed of 19 rules of to be accomplished by 2022. One of them establishes the need of achieving about 80 % of efficiency

in each unit until 2016. The efficiency index must be calculated taking into account the number of graduating students and the number of places offered during the correspondent entrance exam for each courses (BRASIL - MINISTÉRIO DA EDUCAÇÃO, 2010).

Completion rates for groups of courses offered by the BFNPSTE, from 2004 to 2011, were published by BFAO. The chart in Figure 1 shows 46.8 % completion in vocational education, the high school in BFNPSTE; 37.5 % in the PROEJA – a national program for Professional and Basic Education Integration taking into account Youth and Adult Education; 25.4 % in teachers training; 27.5 % in Bachelor degree education; and 42.8 % in technological degrees (BRASIL - TRIBUNAL DE CONTAS DA UNIÃO, 2012).

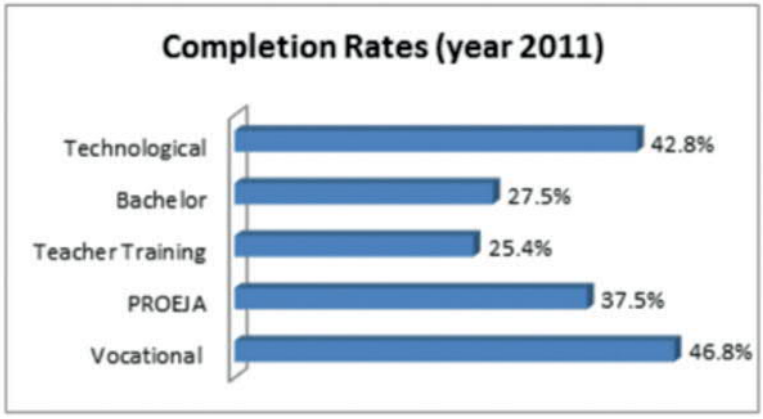

Figure 1. Completion rates per group of courses offered by the Brazilian Federal Network for Professional, Scientific, and Technological Education – from 2004 to 2011.

It was also stated by the BFAO that the target completion rates expected in the NEP, as well as the efficiency in all the courses offered by the BFNPSTE, expected in the ATC represented achievements not feasible in short term (BRASIL - TRIBUNAL DE CONTAS DA UNIÃO, 2012, p. 10).

The Federal Institute of Education, Science and Technology of São Paulo (IFSP) is a group of schools in the BFNPSTE. Its management report for 2014 (IFSP, 2014) states that the dropout rates are also far away from the goals established in the NEP and ATC. Despite the fact, some improvements are observed about the completion rates, as illustrated by the chart in Figure 2. Also noticeable are the targets suggested by the BFAO, represented by vertical marks.

Furthermore, besides the dropout rates indicated by Figure 2, there is another huge challenge that IFSP seeks to overcome. Its data from the year 2014 show that the students' failure rate was about 25.6 % (IFSP, 2014).

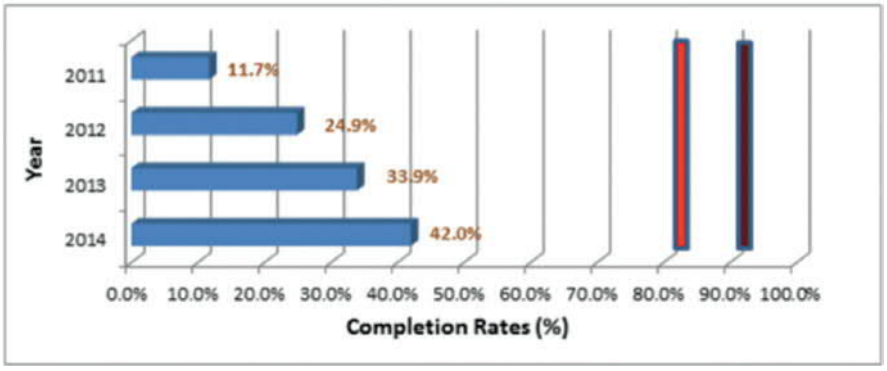

Figure 2. Completion rates, over the period 2011–2014, in the Federal Institute of Education, Science and Technology of São Paulo, and the targets described in the NEP (90.0 %) and ATC (80.0 %).

Thus, the Brazilian Ministry of Education defined guidelines to overcome dropout and student failure issues in BFNPSTE. From its content it is possible to observe that the causes for them may be related to the following (BRASIL - MINISTÉRIO DA EDUCAÇÃO, 2014, p. 17–18):

a) Access to the schools;

b) Student relationship issues (mainly with teachers and colleagues);

c) Socio-economics factors and conditions;

d) Frustration over the expectations related to the course;

e) Intra-school factors (curriculum, time table, and academic load);

f) Student motivation, interests, and commitment levels;

g) Insertion of students into the productive world, specially their need for a job;

h) The school teaching model as well as its values;

i) Learning issues or difficulties related to subjects;

j) Grade repetition or insuficient academic performance;

k) Distance between the theoretical curriculum of the course and the practical knowledge required by the worklife;

l) Inadequate internship programm;

m) Pedagogical practices;

n) Teaching staff profile;

o) Excessive number of subjects by course period;

p) Teachers' demands;

q) School structural features;

r) Weak relationship with the school;

s) Student behavior and attitudes towards school life;

t) Disabilities in previous education (primary and/or high school); and

u) Opposition to the vocational education laws, as well as to their students perspectives.

The approaches presented in this paper represent actions alligned with those guidelines, aiming to contribute to the accomplishment of targets, and according to the following items in the categories of causes:

a) **Individual aspects** – abilities and skills for studying, and compatibility between the academical life and the world of work needs;

b) **In-school aspects** – social inclusion and respect for diversity, and didactic-pedagogical questions; and

c) **Out-of-school aspects** – job opportunity for former students.

3. The approaches and methods

As stated previously, the student motivation, mainly in vocational schools, may be affected by the distance between theory and practice in real life, and the lack of attention to active inclusion of students with special needs. They represent the essence of the applied approach for dropout rates reduction. Sustaining it, as depicted by the diagram in Figure 3, there are the following three main action lines:

a. robotics as a motivational and pedagogical tool;

b. inclusion as a way of promoting student success, and

c. a multidisciplinary Project-Based Learning (PjBL) application approach, taking into account needs from the productive sector.

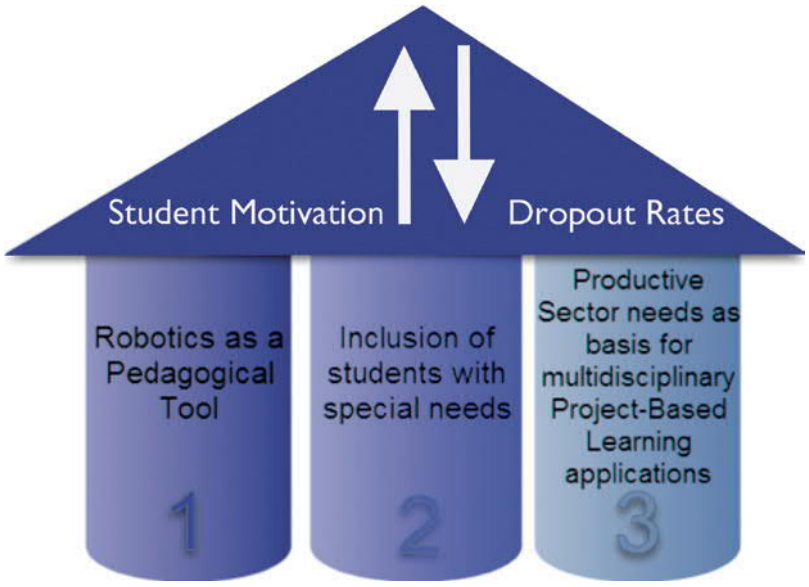

Figure 3. The applied approaches and methods.

3.1 Robotics as a motivational and pedagogical tool

The educational process must be in constant modification in order to develop aware, ethic and responsible citizens, fully integrated into the working world which is becoming more complex, and changing rapidly. However, there is a kind of teaching practice stagnation, usually centered on the expository method, which does not end up following the current social transformations and demands.

In order to tackle the problem of low motivation level of students, the use of the Problem-Based Learning (PbBL) method associated with autonomous mobile robots application is proposed. The robots represent a high-quality educational resource that contributes to social inclusion, vocational training and knowledge production, also facilitating technological innovations. In addition, they provide ways to explore logical mathematical reasoning, physics concepts, computational methods and electro-electronics knowledge in a challenging and motivating working environment that also promotes the development of creativity, team working and leadership skill.

Towards this end and after feasibility analysis, educational robot kits may be used for promoting robotics competitions that involve concepts covered by different areas. Therefore, these initiatives encourage the students to stay in the school, align the curriculum to the socio-economic

needs, and increase cultural, scientific and technological development of the surrounding community.

3.2 Inclusion as a way of promoting student success

When facing the challenge of teaching special needs students, not only a physical structure is necessary. The awareness of the people who those students will interact with is also required.

There are different types of special needs and then, it is not possible to provide a unique solution for all the questions related to the promotion of inclusion. Thus, it was decided to focus on deaf students. This focus was defined based on previous know-how, mainly from one member of the team responsible for the work presented in this paper.

In Brazil, deaf students are commonly placed into conventional classrooms with only the support of a Libras (Brazilian Sign Language) interpreter. However, this strategy puts the deaf student in an isolated situation from the rest of the classroom.

Although the Libras could be the second language in Brazil, few people master this language. It hinders communication and, therefore, the inclusion of deaf students in the teaching environment. In many cases, deaf students drop out from the teaching environment because they are not being able to interact with their colleagues, teachers, and other professionals in the school.

In order to promote the integration of deaf students in the classroom, a strategy supported by didactic tools that facilitate the exhibition of subjects in a visual way is proposed. Thus, it is expected to get an increase in deaf student public numbers throughout school events, as well as to facilitate clear interaction between the hearing people and the deaf.

3.3 Multidisciplinary Project-Based Learning application taking into account productive sector needs

Projects are being considered as strategy for teaching in many initiatives around the world. Some of them are not named, like the strategy applied by Cunha, Martins, Ferreira, & Anjos (2005), for instance. However, it is possible to realize that most of them present features related to the so called Project-Based Learning (PjBL).

As stated by Buck Institute for Education - BIE (n.d.), PjBL represents "a teaching method in which students gain knowledge and skills by working

for an extended period of time to respond to an authentic, engaging and complex question, problem, or challenge". It also states that "the experience of thousands of teachers across all grades levels and subject areas, backed research, confirms that PjBL is an effective and enjoyable way to learn and develop deeper learning competences required for success in college, career, and civic life". Due to its features, PjBL represents an active learning method or methodology that fits the 21st century education needs, having in its basis approaches like student-centered learning and Learning by Doing.

An interesting and noticeable method that has PjBL, student-centered learning and Learning by Doing as basis is the MiRami Method by Lehtinen & Grönvall (2015). It goes beyond putting together principles, values, pedagogy and tools. Agile Project Management based on Scrum method (Scrumstudy, 2016) is applied together with the Learning by Doing technique, as reported by (Lehtinen & Kalliomäki, 2015). Gamification, coaching, and team learning are also considered.

Projects in classroom can either consider the involvement of companies from the productive sector or not. However, specially for vocational education, this involvement can be fruitful for both: schools, teachers, students, and companies.

Having this in mind, it was decided to propose an action line about the multidisciplinary application of PjBL addressing the needs of a company invited to engage in the initiative. In this case, it is a wood furniture production and sale company that has an automated plant involving tracks and robots for cutting, drilling, and painting. It also involves machines like saws, sanders and planers.

Due to the existing number and sort of automation equipment, the power consumption, apart from representing a local environment issue, is considered critical in the company´s Chart of Account, needing to be assessed and well controlled. Another issue in wood furniture industries is that they commonly produce lots of sawdust every day and need to give a correct and preferable profitable destination for this solid residue.

Taking these needs into account, some PjBL initiatives could rise based on derived driving questions. They are able to provide ways for students to learn lots of topics and perform hands-on experiences in different subjects and fields. The company also may exploit outcomes from those inititatives and further initiatives about teaching as well as about research, development, and innovation, always trying to reach specific goals.

Thus, an approch illustrated in Figure 4 was proposed. Three fields (Industry, Informatics, and Civil Construction) should be noted, and inside them, some Undergraduate Courses (UGC) and High and Vocational School (HVS) courses. It should also be noted that only some subjects, those ones in red color, were involved by defining specific PjBL that refered to derived driving question either about the energy consumption or about the sawdust destination. The fields or areas presented are those existing in the campus where the approach was experienced. It is important to highlight that UGC courses and HVS courses, as well as the subjects in them were selected according to the adherence to the context of needs presented by the company.

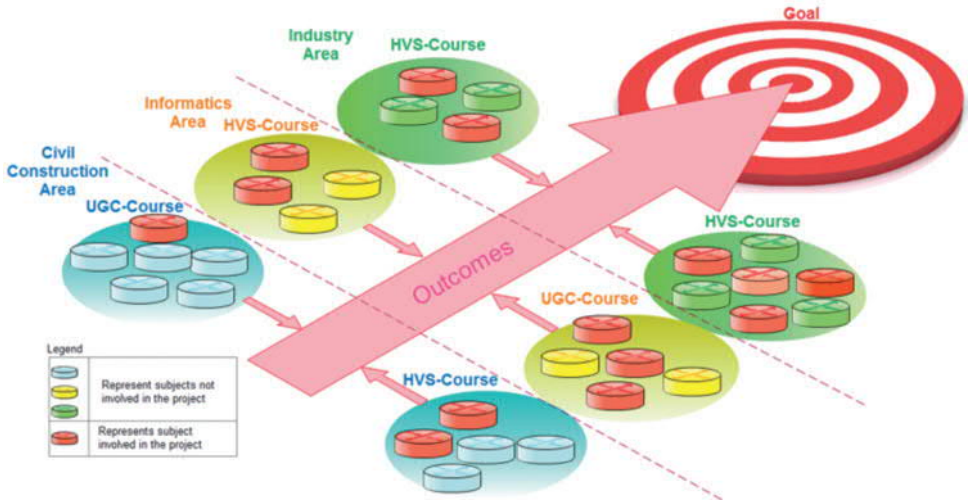

Figure 4. A proposal for multidisciplinary PjBL application taking into account needs of a company.

4. Results and discussion

Actions about the three lines presented above were performed during the year of 2016 in different school units of IFSP in Brazil. The main outcomes are presented below.

In regard to robotics as a motivational and pedagogical tool, activities were performed at IFSP Bragança Paulista campus.

- Measuring students motivation levels;
- Identifying the relations between the dropout rates and student motivation;
- Project and development of mobile terrestrial robots;
- Designing aerial robotics system;
- Participating in a final robotics competition.

The social psychological area has revealed that there are at least two major causes for motivation: the intrinsic motivation (self-determination, competence, task involvement, curiosity, enjoyment, and interest) and extrinsic motivation (concerns with competition, evaluation, recognition, money or other tangible incentives, and constraints by others) (Amabile et al., 1994). However, how can it be possible to measure this motivation?

Motivation, as pointed out by (Touré-Tillery and Ayelet, 2014), could be measured in terms of observable cognitive, affective, behavioral, physiological responses, using self-reports; and in relative terms (e.g. comparing the previous or subsequent levels of motivation).

In the present work, the student motivation scale proposed by Scacchetti, Oliveira, & Rufini (2014) was used, due to the fact that it was specially adapted for the Brazilian vocational students context. This scale is based on a survey, answered by the students that participateed in this project before and after these activities, and by those that were not directly involved in it. After that, all this students data was submitted to an exploratory factor analysis in order to determine the most meaningful groups of items and to examine the internal cohesion of the scale.

Although the final quantitative results that indicate this motivation are still under construction, it is possible to observe some qualitative results. Those students that participated in the design of these robotics were enthusiastic, interested, involved and curious, which indicated the success of this project. Others authors also identify that the use of these programmable robotics enhance students' learning science and technology concepts (Alimisis et al., 2007).

In total, 54 students of the campus participated in this project that involved the construction of robots using:

- The LEGO® MINDSTORMS® NXT platform which comprises a wide variety of building materials (regular blocks, gears, pulleys and axles) and a programmable logic controller, thereby providing the opportunity to develop terrestrial robots with limited time and small funds.
- An open-source micro-controllers (i.e. Arduino) to design terrestrial and aerial robotics in a flexible medium for constructionist learning, based on Piaget (1974) thoughts which express that students have a better understanding when they express themselves through invention and creation.

Finally, in order to encourage research and innovative solutions, all the projects participated in a final competition and the best solution presented received an award.

In relation to inclusion as a way of promoting completion, inclusive didactic technologies were applied when teaching astronomy for a group of 22 students in which nine were deaf. The course was entitled "Astronomy for All", and it was offered by IFSP Itapetininga campus lasting 30 hours.

Although the activity was applied predominantly in the astronomy project, the participating professors sent videos of the respective projects which they were translated into Libras (Brazilian Sign Language). In this way, the deaf students could understand and follow what was being presented in the video. The initial screen of those videos is illustrated in Figure 5. They were also published to a Facebook group. Throughout the course, an upcoming relationship was developed among the participating teachers in order to discuss inclusion technologies and to analyze how to fit them into the profile of each project.

Figure 5: Initial screen of promotion videos produced by the team. A) "Astronomy for All"; B) "Learning through real life projects and problems"; C) "Robotics as a pedagogical tool".

On the first day of the course, working groups were formed comprising of hearing and deaf students. The formation of those groups were suggested by the teacher, in order to encourage interaction among the two groups. Moreover, the deaf community has the habit to baptize with signs the people who do not belong, and so they are identified within the language of Libras, as represented in Figure 6. All the hearing students were baptized with signs that usually highlight some physical or corporal characteristics. Videos with those signs were recorded in order to remember the baptism.

This baptism brought hearing students closer to the environment we call deaf culture, and it was possible to observe a friendships promotion and a new vision of communication and culture.

Figure 6: (A) First screen video of the participant José Eduardo, as baptism event; (B) An example of classifier created to work with the deaf students1.

Before starting the activities of the day, about ten minutes were spent creating "classifiers" that would be worked on in the classroom. Those classifiers are signs that specify a context of astronomy. In case they officially did not exist in the Libras language, they were created exclusively for our group. Other classifiers by other groups could be found on the Internet. As an example, Figure 5B shows a classifier of an astronomical length unit called "light years". All the classifiers were recorded in video and published into a Facebook group. This work helped the fluency of the communication and thus the understanding of the subject matter.

Visual technologies were predominantely used to develop contents for the course. They are not exclusively for deaf students, but they can be perfectly applied to hearing student as well.

Theatrical activities were also applied to facilitate the teaching and learning of the movements of the Sun-Earth-Moon. Simulators of the planetary system enabled visual explanations, and videos containing Libras translations were recorded and posted into a Facebook group.

The evaluation process was divided in two stages: the first one proposed an activity using the software software Kahoot ® (www.kahoot.it). It presents questions for the students to answer in team. All the questions were translated into Libras, and it was only allowed to answer when the whole translation was finalized. The winning group received an award. The second stage of the evaluation was an application of PbBL method in which the groups had to operate a telescope to locate three astronomycal objects in the sky. In this practical and visual activity the deaf students had great ease and contributed a lot to the respective groups, indicating the aptitude they had in equipment that required geometric visualization and alignment mechanisms.

Throughout the course the dropout of one hearing student was observed, while there was an increase in the deaf students (an invasion) from five to nine. That represents a clear indication of increased motivation, practically a null dropout.

As a spin-off and multiplier effect of these initiatives, a formal bilingual mechanics course was designed and offered by IFSP Itapetininga campus in which there were deaf students enrolled and fully integrated into the school environment.

Finally, with regards to the multidisciplinary PjBL application taking into account the needs of the productive sector, training on PjBL and PbBL was offered in blended style to teachers from IFSP Votuporanga campus. It comprised contents and pratices about: learning theories that represent the basis of PjBL and PbBL; introduction to PjBL and PbBL techniques; collaborative learning and student centered learning approaches; coaching and assessment in PjBL and PbBL; project management methodologies and their application in the 21st Centrury Education; and design, elaboration, aplication and development of PjBL and PbBL initiatives. Some digital tools were also presented that could be directly applied in classrooms aiming to motivate students to participate and get involved.

The live portion of the training included four face-to-face meetings that lasted for nearly five hours each. They were conducted by presenting materials and performing dynamics such as: World Café; teamwork and coaching skills development; collaborative and online work, Fishbowl discussion; brainstorming about PjBL and PbBL application taking into account subjects from different courses, in differente fields, offered by the participants; XP (eXtreme Programming)/SCRUM Game to develop skills about sprint planning and execution; PjBL design and elaboration based upon BIE (Buck Institute for Education) templates.

As presented previously, according to prior agreements and understanding with the engaged company, the following two primary needs were selected in which the school could contribute by addressing issues related to:

a) better knowledge of the detailed power consumption by the production plant, contributing to finding alternatives for reducing this consumption; and

b) better use of solid waste as wood sawdust.

Based on these needs, eight initiatives about PjBL application were designed, planned, and some of them executed during the last bimester of the second semester of 2016. Table 1 presents and describes each of them. It should be noted that they are related to different subjects from different courses and grade levels (Techinician - TEC, High and Vocational School - HVS, and Undergraduate - UGC) as depicted in Figure 4.

Table I - Multidisciplinary PjBL application proposals taking into account the needs of the wood furniture industry.

Addressed Need	Grade Level-Course/Subject	Title and brief description of the PjBL
Energy Consumption Awareness (a)	TEC-Electrotechnology/ Energy Efficiency	**A solution for monitoring and measuring individual electrical outputs supporting Power Consumption Management** – The students had to carry out reasearches and studies about feasible and available power consumption data loggers, providing ways of performing individual equipment analysis. By means of a competition the best alternatives of data loggers were selected and presented to the company.
	HVS-Informatics/ Programming Language	**Power Consumption Analysis Software** – Teams of students acting like software development teams worked aiming to produce a software able to read data from data loggers, and shows the data in visual tables and charts. The development activities were managed by applyind the SCRUM method and the results, as software, were presented to the company that may adopt the solutions as a starting point to develop its own.
	TEC-Electrotechnology/ Electrical Facilities	**Power Consumption Analysis** – Teams of students were required to perform analysis about the company´s power consumption based on real data provided by it.
	UC-Systems Analysis and Design/Web Programming Language	**A software for cataloging machines and their motors data** – Like software development teams students worked together to produce a software tha implements a catalog of machines and their motors data, aiming to provide ways of better know the current setup of the production plant as well as to perform studies and analysis about possible power consumption reduction taking into account the company´s machine features.
	HVS-Informatics, and Mechatronics**/ Physics	**Mechanical advantages and energy efficiency in wood furniture industry process** – Students from two courses (Informatics and Mechatronics) were required to study and analise some mechanical process in the wood furniture industry process and verify possible advantages as well as the energy efficiency.

Addressed Need	Grade Level-Course/Subject	Title and brief description of the PjBL
Wood sawdust utilization (b)	**HVS-Informatics, Mechatronics, and Civil Construction*/ Biology**	**Prime destination for wood sawdust produced by wood furniture industries –** A contest about the best ideas for wood sawdust utilization taking into account laws and legislations, local environment issues, and enterpreneurship.
	HVS-Civil Construction/ Building Architecture Mockups	**Wood sawdust application as building architecture mockups finishing –** Students were invited to use the criativity and produce building architecture mockups by considering possibilies of applying wood sawdust as material. The mockups were presented in an event organized by the teacher and called Breakfast with Mockups.
	HVS-Mechanics/ Computer Aided Design (CAD)	**Designing a brick that is partially composed by wood sawdust –** Students were required to design a brick, using a CAD software. The brick is for specific purposes, and the use of wood sawdust as a concrete aggregate is considered. This initiative can produce useful outcomes in the context of another initiative related to Research, Development, and Innovation (R&D&I).

Partnerships between schools and companies are commonly represented by trainee programs. In this case, we are experiencing alternative forms to get needs and problems from companies and put them into the classroom and laboratories.

Most of the time, partnerships in this sense are not so easy to establish, mainly if the companies are small or medium size. One reason for this is because they are commonly focused on short term and profitable activities and rarely have available free time in agenda for meetings and for giving attention to teachers and students. However, it is believed that it could be fruitful to take account of the following:

a) Insist and persist to gain the companies' attention offering oportunities to work together on problems that matter to them;

b) Avoid interfering with the routine of the company, always respect its availability and conduct as short and quick meetings as possible;

c) Show all the time that we are attentive to the company´s privacy, always request permission to access places and information and, with regard to the latter, and always verify the need for disclosure;

d) Clearly present the intention of producing useful outcomes and minimal or no investment;

e) Take plenty of time expecting investment from the company, trying to demonstrate, in the first instance, that the school, by means of teachers, researchers, technicians and students, is capable of effectively producing returns on investment.

By considering the achieved outcomes from the three presented lines of action in relation to the previously mentioned 21 causes of dropout and retention issues in BFNPSTE (BRASIL - MINISTÉRIO DA EDUCAÇÃO, 2014, p. 17–18), it is possible to notice contributions that ameliorate at least nine causes:

(a) access to the schools;

(b) frustration of expectations related to the course;

(c) students motivation, interest, and commitment levels;

(d) the school teaching model as well as its values;

(e) learning issues or difficults related to subjects;

(f) grade repetition or insuficient academic performance;

(g) distance between the theoretical curriculum of the course and the practical knowledge required by the worklife;

(h) pedagogical practices;

(i) the school structural features.

5. Conclusion

This paper presented an empirical effort to assess intrinsic and extrinsic student motivation and relate these factors with the dropout and retention rates.

Although the presented results have some preliminary aspects, the educators could generate a more precise understanding about how activities, such as robotics, could relate to students' cognitive and affective outcomes. Therefore, this could improve the classroom learning environment and reduce the dropout rates. Informally, it was possible to observe a substantial increase in the student motivation.

Regarding the inclusion of deaf students, it was possible to observe a real integration between the deaf and the hearing culture, as well as an increase in the motivation mainly of the deaf. The technologies developed in this topic are strictly visual, and so they can be used not only with the deaf, but also with any group of students.

Finally, with regards to the PjBL application taking into account needs of a company, it was possible to observe efficiency and effectiveness in promoting students' motivation, mainly due to the charateristic of providing a firm connection between theory and practice or at least the perception about the application of the former. Teachers and students involved reported that they were feeling excited, mainly due to receiving attention from the company, as well as having the oportunity of realizing the importance, in some sense, of what they were teaching and learning.

Acknowledgements:

We would like to thank: the IFSP; the Brazilian Ministry of Education, and the National Council for Scientific and Technological Development (CNPq); the Tampere University of Applied Sciences (TAMK), the Libras interpreters Lucélia Miranda Massoni and Greice Pinheiro de Almeida for participating in the astronomy course for deaf students; and the company Pollus Móveis Comércio e Indústria de Móveis Ltda that gave us attention and opened its doors to our school.

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