Pilot Research of Teacher Placement: Are Industry and STEM Classroom Different Learning Environments?

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Abstract: The rapidly changing modern world is creating new demands in the workplace. This connected with challenges in educating young people. Teachers are called to provide high quality teaching and learning methodologies so that young people can develop knowledge, skills and attitudes to be able to transfer safely into the world of work. This article describes the objectives and the results of the pilot participatory research with my placement in the food industry as a unique professional development opportunity that links the classroom to the workplace. Through the data collected and analyzed from active participation in tasks, services or activities in the workplace and interviews with different sections of the food industry, this article analyzes the similarities and differences in industry with classroom instruction. The main result of this paper is that such teacher placements increase the teacher's ability to link theory and practice with the proper planning of learning and teaching activities, understanding of workplace practices (e.g. problem solving methods, practical applications of theory) the importance of student learning. This completely and comprehensive view of occupational tasks needed in industry, provide as proposals innovative teaching methodologies and evaluation form based on the activities and tasks performed into industry in relation with required skills.

Keywords: Teacher placement, Industry, Knowledge, Skills, Attitudes

Introduction

A series of global labor force studies and consulting shows that a significant proportion of employers have difficult to find candidates to fill their vacancies (European Commission (EU), 2015; EU 2014; EU 2013; Dobson, 2013). The rapidly evolving economies and revolution in the world of knowledge and information, which is also termed the fourth industrial revolution, highlight the urgent need to prepare young people to be capable of responding to all these changes (World Economic Forum, 2016; Arntz et.al, 2016). By 2022, the skills required to perform most jobs will have changed significantly. Skills being developed include analytical thinking and active learning, as well as digital skills. However, the adequacy of new technologies is only one part of the 2022 skill equation. Human skills such as creativity, originality and initiative, critical thinking, persuasion and negotiation will maintain or increase their value as well attention to detail, resilience, flexibility and complex problem solving. In that ways, as our economy and society change, education will be even more important than ever for jobs, prosperity and social inclusion. The role of education is critical to equip young with knowledge, skills and attitudes in order to find a quality job position (OECD, 2019; Toner, 2011; Gray, 2016).

Stakeholders and educational policies promote the development of school and industry partnerships (Gonski et al., 2018). The common goal in many European Countries is to develop closer cooperation or partnership with industry with expanded trend to include not only in vocational schools, but also in general education systems (EU, 2016). However, there are certain system-wide exclusion mechanisms and obstacles such as i) the lack of time to prioritize school-industry partnerships among other priorities in schools ii) the delivery of the national curriculum iii) structural barriers iv) procurement policies and child safety requirements (Torii, 2018). The emergence of these new relationships between education and industry has highlighted the need to examine and attempt to identify teachers' work. The current challenges in education focus on teachers' ability to make these links between education and industry (Perry & Ball, 1998). The teachers could have a central role not only to better understand industry needs and expectations but also to transfer workplace-related skills and competencies to their work with students. Under this framework, this article examines the results of teacher participating in a short-term placement in a food industry and analyzing the additional values in teacher professional development.

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Teacher Placement in Industry as Force of Professional Development

Schools are learning organizations that need to be connected and integrated within an educational system where decision-makers can learn from developments in and around schools. In addition, they should encourage and facilitate teachers and school leaders to simultaneously improve both their pedagogical and organizational practices through local collaborative research, networking and continuous professional development (European Commission, 2017a; Lepani, 1993, National Industry Education Forum, 1993). The continuous professional development of teachers strengthens their position and key role in the transmission of knowledge and shared values and in the provision. The most common forms of professional development are participation in conferences and workshops (Stone, Kowske, & Alfeld, 2004). However, such activities are discouraged, as they are not effective and productive strategies to ensure that teachers remain up-to-date with all aspects of current developments. On the contrary, internship programs that provide workplace experiences are preferred (Perkins, 2006; cited in Geralyn, 2011).

Moreover, the main task of teachers needs to be redefined, as there are often misunderstandings between the work associated with the role of teacher as educator and teacher as manager. Teachers are often not seen as 'working' in the same way as 'working' in industry, although teachers face similar situations to those in industry, such as restructuring awards and measuring performance outcomes. Comparisons between teachers 'work and industry expectations indicate that teachers' work may not be much different from 'industrial work' and that there may be common skills and competences, common models for the development of new knowledge products and assessment frameworks (Ashenden, 1990 cited in Perry & Ball 1998).

Under these frameworks of professional development of teachers in order to be familiar with the workplace of industry the teacher placements are an emerging educational change. STEM teacher placements in industry are work placements or internships that provide opportunities for STEM teachers to upgrade their knowledge, skills and competences in science, technology, engineering and maths, as well as to improve their teaching of STEM subjects. Teacher Discovery Placement scheme (European SchoolNet, 2017), is an initiative of the STEM Alliance1 in collaboration with the SYSTEMIC project and it aims to assemble a significant number of relevant practices of current teacher placements, in order to highlight the diversity of existing ones. Taking under consideration the above described challenges, this pilot research focus in examination how effective could be teacher placement in industry for development the ability to understand the required knowledge, skills and attitudes that teachers have to cultivate in teaching and learning activities.

Method

The participatory observation to the food industry research, where the researcher and the educator are the same person, lasted for 40 working hours (5 days to 8 hours daily). The food industry is a state-of-the-art product manufacturing plant located in the Peloponnese with a total area of 5,200 sq.m. , with 40 employees on a daily basis. There the main product categories of the company are manufactured according to international standards, where they are exported locally and internationally. Participatory observation for data collection includes methods for generating data other than observation, such as in-depth interviews, informal discussions, the use of written evidence and, in particular, the researcher's reflection (Flick, 2006).

The observations were focused on the operating areas of the production departments, but mainly on how they were operated. Dialogues and questions with the staff of the departments supplement the observations, with the main objective of being able to obtain a complete description of its field industry, the people and the tasks that took place there. Throughout the observations and dialogue, I wrote notes that were processed and analyzed at the end of each day to draw the conclusions. Interviews with the director of the production industry and the director of the research and development department include questions on (i) analyzing the requirements skills a employee in order to undertake work in the food production industry (ii) an overview of the methods of organization and operation of the departments of industry. Their responses were checked and evaluated during my active involvement in the factory, where I was called upon to perform specific tasks under the supervision of a mentor. Finally, the collection of artifacts/ documents for (i) the objectives set by the industry each year (ii) the crisis management policies (iii) the annual employee evaluation form used are important additional elements for the research the field of industry. The most important part of the research is the reflection, that is, the processing of the data, recorded throughout the participatory observation, so that it can be interpreted within the STEM classroom and the researcher-educator draws conclusions about (i) the skills needed develop students to take an active role as employees ii) teaching methods and practices.

Results

Skills, Attitudes and Knowledge in Industry and STEM Classroom

Analyzing interviews in combination with observations of daily tasks of workers in industry and tasks that I had to achieved during my placement provided an overview of comparison skills in industry and skills in STEM classroom (see Table 1) and an overview of comparison attitudes in industry and attitudes in STEM classroom (see Table 2).

Table 1. Comparison Skills of Employees in Industry and Skills of Students in STEM Classroom

Skills of employees in food industry	Skills of students STEM classroom
"…Collaboration and interaction in teams: If employees do not work as a team not only with strong links of collaboration between them, but also with collaboration between different parts of production the daily plan of production cannot be achieved and there is a high likelihood of objectives being set down…"	-Collaboration -Team working -Social skills
"…all workers should be able to solve problems that arise unexpectedly in the daily operation of the production unit..."	-Problem solving
"…He/She should be able to describe the problem accurately, communicate and transfer information as quickly as possible to the relevant departments…"	-Communication skills -alertness to all possible situations/ strategies -Make decisions
"….It is very important that employees are aware of the goals of the industry from the start so they will be focused on what they want to achieve on a daily basis so that they can meet their time management skills…."	-Management skills -Leadership skills
"…Employees of selling department need creative thinking to be able to business executives in order to best promote company products…"	-Creative thinking
"…Employees in the production department where it combines barcodes to produce new products need detailed and concise thinking..."	-Analytical and critical thinking

Table 2. Comparison Attitudes of Employees in Industry and Attitudes of Students in STEM Classroom

Attitudes of employees in food industry	Attitudes of students in STEM classroom
"...work according to moderation and logic...," ...which explains "not to exhibit extreme behaviors, to obey the rules and standards that must apply, but not to be a passive listener..."	-Students set their curiosity in STEM environment. -Ask questions and demonstrate open-mindedness and inquisitiveness.
"…Respect for diversity / different views: He/ She should be able to respect his/her colleague, who performs different tasks than his own and has different views on how to execute and organize, but together they aim to produce a product..."	-He/She show flexibility and openness to changing strategies of problem solving, methods, opinions or goals in light of new information and changing circumstances. -He/She could work both independently and part of a team to achieve objectives of STEM subjects -Respect the diversity in a classroom -Openness to listen the views and opinions of his/her schoolmates.
"..He/She feels the workplace as his/her own ..."	-He/She feel safe in STEM classroom environment, as his/her home with the support of educator.
"… .. He/She could integrate into the framework and rules applicable in the workplace…"	Adaptability to the requirements tasks of curriculum and timetable/ daily program of STEM classroom
"... He/She has faith in what he does ..."	-Persistence to achieve the goals of each learning STEM tasks -He/She has the ability to sustain interest, effort and motivation to persevere in accomplishing a task or goal.
"…He/She becomes part of the workplace society and must comply with applicable law…." *"…We have to work both independently and part of a team to achieve objectives of daily production..."*	-Individual liability to achieve the goals of his or her performance through exams or through worksheets -Responsibility to set personal and professional goals, be accountable for actions, consider the needs of STEM subject and requirement tasks presented by educator. -Honesty to implement the rules needed in examination or daily tasks

In the framework of needed *knowledge* of employees in industry director of human department mention that *"... Industry call for employees with work experience, that's why it is important to have training programs by up to secondary and higher education certifying their experience in the workplace…", "..As we know this is not possible, so we offer professional development seminars, but the emphasis is on the practice of implementing the knowledge and not on theory….", "…Employees during their training should be able to listen ... and then put into practice ...", "Learning by doing" is a key principle for the food industry to operate…"* Under the same framework, teaching and learning in the STEM classroom based on the theory of education «learning by doing» and it is a hands-on approach to learning, meaning students must interact with their environment in order to adapt and teach (Dewey, 1997). The teachers faced the challenge to present real life problems to the students and then guide the students to solve the problem by providing them with a hands-on activity to learn the solution. One the hand teacher is the supervisor and the mentor is STEM classroom who support the learning process and on the other hand in food industry *"…On a daily basis the company supervises the workers as there is the responsible person in each department to provide support instructions and corrects any errors. The mentor is responsible to monitor and correct the quality performance of products…".* In particular, teachers are responsible to prepare the young with new knowledge and the methodologies of teaching follow the models of Research and Development Department (RnD) in industry, where the new knowledge represented by the new products for future labor needs.

Research and Development Department (R&D): New Products and New Knowledge

R&D consists of the research activities that an industry or business chooses to do with the desired result of a discovery that will create either a completely new product, product range or service. R&D is not just about creating new products (knowledge) as it can be used to enhance an existing product (knowledge) or service (knowledge production process) with additional features. The comparison of expected results of of R&D in food industry and expected results of teaching in STEM school curriculum (see Table 3) give the motivation of creating common models of food production and knowledge. However, in order, R&D is an important means of achieving future growth and maintaining a relevant product in the market, it has to follow a methodological operation strategy plan. In that ways plans of R&D in industry could modify in R&D methodological plan in STEM classroom, to express the important means of achieving the future development of a student's skills and maintaining a relevant knowledge product in the relevant discipline.

Table 3. The Comparison of Expected Results of R&D in Food Industry and Expected Results of Teaching in STEM School Curriculum

Objectives and expected results of R&D in food industry	**Objectives and expected results of teaching in school curriculum**
Improvement of products so that they always meet the relevant legislation, consumer needs and objectives of the industry.	Developing innovative teaching methods that meet i) the legislation of curriculum in each stage, ii) the needs of each student iii) the future trends in education for preparation the young as employers in the workplace
Finding/ searching the right raw materials and packaging for the Industry's products, existing and new.	Finding the right supportive teaching materials (interactive media, digital tools for knowledge products, existing and new)
Finding new technologies, methods and processes aimed at improving the production process in collaboration with the Production and Technical Support departments.	New technologies, innovative methods inquiry learning processes aimed at improving the methodological process of new knowledge in collaboration with other disciplines in order to support the disciplinarily.

Common Model of Food Production and New Knowledge

Koberg et.al (1991) describe the ways in which new products are created starting from problem identification, which are transformed into reflection ideas and subsequently into original and ultimately innovative products. The authors suggest that all problems can benefit from the same logical process. The methodology and the steps used to solve many complex problems are: (1) Acceptance of the situation, (2) Problem analysis, (3) Goals and solutions, (4) Selection of methods, (5) Application of solution techniques and (6) Evaluation of results. In the industry when designing a new product or redesigning an existing one, it is important to clearly identify what problem it is trying to solve through this new product, namely to analyze a situation of low sales or low quality.

Through the analysis of the problem parameters, the goals and corresponding solutions will be set. It is very important to consider the client and his requirements and desires from the beginning to the end of the product, in order to properly choose the method of implementing the implementation strategies. Finally, a critical and detailed view of the process needs to be taken, with the necessary changes to be made. With this approach and mindset, creating successful product designs will become a more systematic process and the resulting products will have a long-term impact on consumers. Can this plan be adapted and applied to the teaching of the lessons? The answer is that since this model works to solve all problems, it could perhaps also be adapted to study the problems of today's society, so that students can study and understand important problems in today's world, find solutions, and to recognize the connection of science.

The example of teaching and learning about the problem of climate change illustrates the pilot model that could be applied to both the food industry and the STEM classroom. (1) Students are invited to discuss problems recorded in the environment (average global warming, ice melting, rising sea levels) through pictures, figures, graphs, videos, etc. (2) The analysis of the problem of climate change is to investigate the causes (eg increase of pollutants in the atmosphere). (3) Students are encouraged to think creatively to propose innovative solutions to the problem, always taking into account the human factor and improving the quality of his life without risk to his health.. (4) Alternative energy sources (wind, geothermal, nuclear, etc.) may be a method to limit air pollution. (5) The use of digital tools can be used to understand the implementation of problem-solving strategies. (eg the digital tool http://www.wwf.gr/footprint/ will suggest implementation methods and techniques) (6) At the end of the learning process students evaluate the process through questionnaires with five choice scales: 1 (strongly agree), 2 (agree), 3 (n / a), 4 (disagree), 5 (strongly disagree). Questions may include: i) The importance of the results of knowledge about the climate change scenario for their daily lives, ii) the positive and negative aspects of the teacher script, iii) the impact on students' attitudes and knowledge.

Evaluation Form of Employees in Food Industry as Evaluation Tool to STEM Classroom

Both the evaluation of employees' performance and students' performance has a significant role and meaning in the quality of production and knowledge (see Table 4).

Table 4. Employees' Evaluation Form of the Food Industry

	Not satisfactory Grade 1	Moderate Grade 2	Good Grade 3	Very good Grade 4
Quantity of work Accuracy, completeness, regularity, diligence, consistency, dedication to work, avoidance of mistakes.				
Quality of work -complete work in time -willingness to do work and help colleagues -presents samples of planting, indifference and fatigue				
Abilities -analytical and combinational thinking -easily adapted to the requirements of the job -makes quick and right decisions -takes initiative, is innovative is responsible, reliable, caring				
Conduct cooperative, kind, communicative, trustworthy, faithful to principles and goals				
Work habits -He makes good use of the means provided to him/her -Observes procedures and forms -It follows the rules and respects them -Misconduct penalties? -Keeping a schedule - unjustified absences -Comply with hygiene and safety rules				
Evaluability -He/ she has the ability to improve -Are there personal goals to be achieved?				

The results of those evaluation procedures could be taken under consideration in the model of production. It is critical the definition of evaluation criteria, that's why the evaluation form of the food industry is suggested to be used as analytical evaluation form, as describes many components of learning process. This evaluation form could be a useful tool for teacher because it includes attitudes and skills of students' performance. The result is the average score= sum of grade in each line divided with 7. It is very important that this form completed by comments of the employee and the directors of each department in industry and after discussion they set goals for the next period. This strategy of evaluation could have additional pedagogical value in educational systems, because each student is a personality who needs personal suggestions for development skills and attitudes and not only grades for evaluation the knowledge.

Conclusion

In this pilot research, the educational goal was to increase the ability of the teacher to link theory and practice to convey through appropriate designed learning and teaching activities an understanding of workplace practices (eg problem solving methods, practical applications of theory) in the classroom, thereby increasing the importance of student learning. Conversely, teacher involvement in industry activities could examine how classroom strategies and content can be applied in the workplace. The educator and researcher gained a complete and comprehensive view of occupational choices, labor market needs, activities and tasks performed, skills requirements, career development scales, standards, problems encountered and opportunities student learning in a targeted industry or career space. Mostly, as basic output is that the teacher and researcher translates this learning into an enhanced, integrated curriculum, teaching methods, work-based learning opportunities for students and evaluation form.

Acknowledgements

The STEM Alliance (www.stemalliance.eu) is an industry-education cooperation initiative coordinated by European Schoolnet and CSR Europe which aims is to promote Science, Technology, Engineering and Maths education and careers to young Europeans and address anticipated future skills gaps within the European Union. The STEM Alliance has published the "Teacher Placement Initiatives – Collection of Best Practices" booklet, containing a selection of 15 initiatives collected from 10 countries around the world, providing inspiring examples of STEM teacher placements in industry. One of the main aims of this "Teacher Placement Initiatives – Collection of Best Practices" is to help overcome the lack of awareness of career development opportunities for teachers, taking into consideration the urgent need to bridge employment gaps by sustaining cooperation between school and industries. The publication contains precious insights for industry on how to attract new generations of students into STEM careers while understanding the workforce available, allowing a tailored targeting of specific candidates (Retrieved from http://www.stemalliance.eu/documents/99712/104016/TDS+-+Collection+of+Best+Practices/7cfbadca-ae34-4be2-9866-5218efae5be8)

Following the 'Teacher Placement Initiatives – Collection of Best Practices', the guide has been created by a team of education and corporate experts for businesses that are committed to championing and promoting education and employability in science, technology, engineering and maths (STEM). The guide is addressed to those in charge of different types of departments, including Human Resources, Communication, Corporate Social Responsibility (CSR), Outreach or Community Activities, and Education or Training. This publication constitutes the second part of the Intellectual Output 4 'Guide on contextualization of STEM teaching' of the SYSTEMIC project. SYSTEMIC is funded by the Erasmus+ Programme of the European Union. This publication includes guidelines and conditions of success for this type of school/industry collaboration and some analysis on how teacher placements contribute to improve teachers' STEM skills and their capacity to influence students' studies and career choices.

Another European initiate is the DESCI European project (www.desci.eu/) (Valente et.al), which aims to improve the capacity of secondary school to prepare students, intercepting the needs of the labor market, and encourage the development of a European working methodology in secondary schools to ensure equal quality standards, at European level, in the management of the alternating training. DESCI is focused on the improvement of European methodological standards of alternating training in secondary technical and professional School system, through the development, at European level, of a kit of methodological tools for teachers, students and tutors. As part of outputs of Desci Project, re-search team of National Kapodistrian University of Athens analyzed the term of 'alternating training' as an umbrella term, that incorporates all forms

of education or training, combining periods in an educational institution or training center and in the workplace. Finally, this pilot research will be included in the methodology plan of PhD thesis "Connecting Education with workplaces for development skills" using further data of qualitative analysis both in workplaces and in STEM classrooms.

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