



Elements of History and Evolution of Brain Science in High School work-alternative activities

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Abstract

Modern and historical elements of international researches about Brain Science were integrated to realize innovative high school - work alternative activities (PCTO) into interdisciplinary educational itinerary with students that have good knowledge about basic elements of neuroscience. Perspectives in future brain science researches were realized also with different seminars of biology-didactic researcher and one coplanning innovative seminary with neuroscientist about historical and modern aspects of octopus studies for brain science applications; collaborative and creative activities with IBSE methodology learning in contamination between different disciplines. Students have participated to individual and cooperative working, modern laboratories activities for elaboration and interpretation in critical thinking of neuroscience original international articles, also about history and evolution of an neuroelectrophysiology technique. Classes were divided in little groups to realize, with specific role for each student, thematic works about different historical topics: neuroscientists' biographies and discoveries. One particularity of this project was the remodeling of second phase during Covid19 pandemic, realizing some activities in smart working: students with students into different team work and students with biology researcher-teacher, also publishing in innovative digital platform created by biologist-teacher, also writing report in international 2020 brain science digital context. Neuroscientific literacy work and brain science reading activities were realized to create into each group innovative "digital brain posters", simulating role of scientist in realizing professional poster for international congress with guide and instructions of biologist – teacher. At the end of project was organized and realized a Virtual Neuroscience Conference as in real scientific congress with remote digital activities in which all students have presented different parts of realized brain posters. In the project monitoring phase students have expressed your idea about all realized activities important for world of work. Students have compiled terminal report of project in which have declared that digital activities were very useful to develop soft skills in cooperative team work realizing researches and final product of poster with specific role for each member of group. Were important for students oral and written communication skills, also in realizing virtual modern conference as "little scientists"; comparative cognitive competencies in analyzing some international neuroscience articles - reports and in relating elements of biographies of neuroscientists also with debate method.

Keywords: *IBSE methodology, soft digital skills; brain science; multidisciplinary didactics; history of neuroscience; virtual brain conference.*

1. Introduction

Modern and historical elements of international researches about Brain Science were integrated to realize a high school - work alternative activities (PCTO) for scientific High School into modern educational itinerary with students that have good cognitive skills about based elements of neuroscience.

Perspectives in future brain science researches were realized also with different seminars of biologist-didactic researcher and one coprojected innovative seminary with neuroscientist of International Brain Science Research Centre about historical and modern aspects of *octopus* studies for brain science applications; collaborative and creative digital learning with IBSE methodology in contamination between different disciplines, realizing multidisciplinary didactics (Biophysics, History of Science, Brain Science, Physiology, ICT).

With individual and team work, students have participated in different laboratory activities also for elaboration and interpretation of neuroscience international articles with cooperative working about discovery, history and evolution of an electrophysiology technique, integrating different experiences also to answer some questions. Elements of international scientific articles with key words and important concepts to know the different phases of neuroscientist' work also to elaborate written brief text about different questions: which part of article do you think more interesting and why, which more scientific difficulties to arrive at the different applications research of brain science techniques, at witch



theoretical and practical experimental phases did you prefer to participate or to give contribution with motivation of answer.

2. Methods

In the first part of project students have worked with *critical thinking*, elaborating written answers to seminary about brain octopus intelligence and physiology studies: which elements of seminary do you prefer, which are objectives of researches presented, which relationship between scientific and historical disciplines in the seminary, which elements of seminary have permitted you to better understand experimental approaches of scientific researcher, analyzing the different parts of seminary - which scientific elements do you think to be useful for future researches about neuroscience and regenerative medicine with motivation of answer. In *cooperative working* and individual activity all students have also worked reading an article of Nature (The octopus genome and the evolution of cephalopod neural and morphological novelties, Nature 524, 220-224, 2015) and observing a video about Genome of octopus to synthesize innovative elements of these researches presenting in class all important information and to communicate the results of works info team groups also constructing scientific section of brain site platform. A lot of interesting experiments have demonstrated the high capacity of cephalopoda to conserve information and to realize intelligent behaviour in different contexts, important researches also to project biorobot for biomedicine inspired to functions of these animals.

In the second phase of project all students have attended different seminaries of biology professor about "The brain science and the methodology work", "STEM Neuroscience for cooperative working: one innovative experimental technique for the neuroscience", " How to realize a digital platform for the brain science", in which was important the creation and the management of Neuroscience group Team in remote e of project in march 2020, mostly in realizing thematic posters into different team research brain science group.

High School students were divided in five little groups to realize, with specific role in each group (responsible, digital expert, text translate expert, oral and written communication expert), thematic works about different historical topics: neuroscientists' biographies and discoveries (Montalcini group, Golgi and Memory group, European History of neuroscience group, Golgi and Cajal group, Huxley group) working learning by doing. One particularity of this project was the new modulation of second phase of work during Covid19 pandemic, realizing some activities in smart working: students with students into different team and students with biology researcher-teacher, also publishing all written activities in innovative digital PCTO platform and publishing in international 2020 brain science digital context as partnership of international DANA Foundation Brain Science week after accepted documented written proposal of biology professor of classes.

3. Results

Neuroscientific digital literacy and brain science reading activities were realized to create into each group innovative "*digital brain posters*", simulating role of scientist in realizing professional poster for international congress with guide and instructions of biologist – teacher. At the end of project was organized and realized a *Virtual Neuroscience Conference* as in real scientific congress with remote digital activities in which all students have presented different parts of realized *digital brain posters*. In the project monitoring phase students have expressed your idea about all realized activities important for world of work.

Different integrated learning and IBSE strategies were realized in brain science project: from historical didactics research approaches to modern experimental impacts, from biography' *individual work* to cooperative group activities in which all students have specific role (coordinator group, articles' translate specialist, informatics specialist for interactive poster, editor specialist for elaboration communication of different activities and researches, also control written texts). From individual with specific skills for different works to communication social activities for community, different activities realizing sharing all work's products in Brain Science Innovative *Interactive Collection Platform* was useful for evaluation of project by biology teacher.

In this Brain science itinerary were integrated different teaching methodology and strategies to guide students in learning and working by doing: to create an international scientific conference simulation, to consult international scientific database, to participate in brain science platform with cooperative working, to realize job strategies with IBSE research methodology in comparison international neuroscientific articles, to realize innovative digital brain science thematic posters and to present all posters in virtual constructed conference.



All these activities were useful to promote transversal skills related to written reports after reading scientific texts, to participate in active way to scientific seminars identifying key elements, organizing competencies about respect for all work times, collaborative competencies in team work important in job reality. Others transversal skills about relational competencies as students referee or director in different activities, documentaries competencies to produce text also for international publication in Brain Science Week 2020, responsibility competencies in management of brain science group, debate competencies in relation thematic of different groups, capacity to follow the guidelines of professor responsible of project. Technical competencies in using informatics platform, in realizing scientific posters to work world, in individual communication into time work assigned, in using with correct way scientific language, both written and oral, also simulation of Neuroscience Conference. Original work of students was realized in reading and in analysis long and curious text "Rita Montalcini comic story - Montalcini a pioneer in neuroscience"- European Brain Research Institute R. Levi Montalcini (Franco Nobili e Manfredo Toraldo), scientific biography document with motivated identification report by student on which cartoons and images (five elements) were more interesting for team group. All students have compiled terminal report of project in which have declared that different digital activities were very useful to develop soft skills in cooperative team work, realizing researches and final product of poster with specific role for each member of group. Students have considered very important the communication skills in realizing virtual modern conference as "little scientists", cognitive skills in analyzing some international neuroscience articles reports and biographies of neuroscientists (R. Montalcini, A. Huxley, E. Kandel, R. J Cajal, C. Golgi) with elements of historical and modern evolution of researches.

4. Conclusion

Interdisciplinary approaches in distance digital working and learning was an important challenge in working methods for biology professor and students, were useful to create a different dialogue about part of project. Contamination between historical and experimental disciplines science, helping students to work with motivation and interest also in distance work sharing and communicating as little scientists all results of researches, was very important to guide the class in realizing digital elaborations of different activities in *project learning PCTO methodology*. Historical neuroscience itinerary with protagonists of discoveries and innovative technology applied in brain science was very useful to involve in inclusive way all students in reason reflections into scientific high school community, educating in critical thinking to elaborate conscious evaluations and ethical considerations about benefit and possible effect of achievements of modern brain science on social impact, about the future relationship with intelligent machines and devices capable also to do integrative or human replacement functions. At the end of project all groups have presented reports of different activities realized in these PCTO itinerary. Students have answered some questions about different aspects of projects: considerations about historical and experimental elements with also possibility to explain individual idea for future impacts on society of modern brain science researches, to explain which neuroscience aspects of Brain Science PCTO work-alternative itinerary were motivating and orienting for individual future studies and professional career choice.

5. References

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