

Educational Biotechnology: teaching and developing for the future

Helena Carla CASTRO
PPBI, Universidade Federal Fluminense
Niterói, RJ, 24210130, Brazil

Fernanda SERPA
PPBI, Universidade Federal Fluminense
Niterói, RJ, 24210130, Brazil

Antonia CAVALCANTI
Vital Brazil Institute (IVB),
Niterói, RJ, 24210130, Brazil

Miriam PEREIRA
Vital Brazil Institute (IVB),
Niterói, RJ, 24210130, Brazil

Izabel PAIXÃO
PPBI, Universidade Federal Fluminense
Niterói, RJ, 24210130, Brazil

Rafael CISNE
Vital Brazil Institute (IVB),
Niterói, RJ, 24210130, Brazil

Sorele Batista FIAUX
PPBI, Universidade Federal Fluminense
Niterói, RJ, 24210130, Brazil

Ana Regina CAMPELLO
CMPDI -UFF e INES
Niterói, RJ, 24210130, Brazil

Cristina Maria DELOU
CMPDI, Universidade Federal Fluminense
Niterói, RJ, 24210130, Brazil

ABSTRACT

Biotechnology is an important area that hugely contributes to the society - from the transgenic plants that may feed millions (eg. Bt corn), to the engineered and/or cloned molecules to fight against people diseases (eg. recombinant insulin). Currently Biotechnology area is divided into subareas accordingly to topics (eg. Health) and colors (eg. red). However, most articles and homepages do not mention or recognize the importance of the educational approach of the biotechnological themes as well as the educational/orange biotechnology subarea. Due to the importance of Biotechnology, we need not only to recruit new brains to work on it but we also inform widely and correctly the society about it. In this work we reinforced the need of the recognition of the educational/orange biotechnology subarea by describing three different strategies to spread and teach about Biotechnology including: a) addition of educational/orange biotechnology definition in Wikipedia in different languages, b) organization of open events with sign language interpreters for deaf and blind-deaf people, and c) development of a strategy to catch young brains to biotechnology area in a Brazilian public schools stimulating their option for biotechnology careers.

Keywords: Educational Biotechnology, Teaching, Special needs, deaf

1. INTRODUCTION

Although biotechnological processes are used by humankind since 6,00 BC, the term “*Biotechnology*” was created only in 1919 by Karl Ereky to define the interaction between biology and human technology [1].

Classical biotechnology included the production of food (eg. wine, vinegar, bread and cheese) from living beings and was practiced by different ancient peoples such as Babylonians, Sumerians, Greeks and Egyptians. However, the discovery of DNA and transfer genetic material techniques using organisms initiated a new biotechnology stage known as “modern biotechnology”. This event hugely stimulated the research in this area and helped society even more [1-2].

In the 21st century, biotechnology has become one of the key technologies multidisciplinary research areas involving the use of different contents from several sciences to develop a process and/or product. Due to the increased expansion and complexity of biotechnology research and products, in 2009 the Biotechnology Institute from Maryland University proposed the classification of biotechnology by colors to facilitate the identification of its research lines and subareas[3].

Among the biotechnology subareas, four are the most cited in scientific papers: (1) Green Biotechnology, also known as agricultural biotechnology, being an area with large data in recent years with the biotech development applied to the Agriculture (e.g. Transgenic crops) (2) Red Biotechnology that includes health-related products and applications, using organisms or molecules (e.g. antibodies and vaccines); (3) White Biotechnology, which is related with industrial applications and environment (eg. biofuels); (4) Blue biotechnology, involving aquatic resource applications, such as the use of marine or freshwater tissues, cells or molecular components [4].

Orange biotechnology or educational biotechnology is related to spreading the news and contents about this area to the society. It develops multi and interdisciplinary materials and educational strategies about these contents (eg. production of recombinant protein) accessible to the whole society [4-6]. This activity should include people with special needs such as those with hearing and/or visual impairment [6-8]. It also seeks to encourage, identify and attract people with scientific vocation and high abilities/ giftedness for biotechnological research and entrepreneurship [9-10].

In this work we reinforced the need of the recognition of the educational/orange biotechnology subarea by describing three different strategies to spread and teach about orange Biotechnology including: a) the addition of educational/orange biotechnology definition in Wikipedia, the free online encyclopedia that is extensively consulted by the whole world in different languages (Russian, Portuguese, Spanish, Greek, French, Arab, Chinese, Italian), b) the organization of public and free events with the presence of sign language interpreters to propagate the biotechnology concepts for deaf and blind-deaf people, and c) the development of a strategy to catch young brains to biotechnology area in a Brazilian public schools.

2. METHODOLOGY

We added the educational/orange biotechnology definition in Wikipedia, the free online encyclopedia that is extensively consulted by the whole world. We added the information in different languages (Russian, Portuguese, Spanish, Greek, French, Arab, Chinese, Italian) by opening an account and adding the concepts on it.

The events to spread Biotechnologies themes among other scientific contents to society, especially for deaf people, were performed annually by inviting different speakers. In order to increase their interest to these events we also included American (Dr. Donna Jo Napoli from Warthmore College) and Brazilian (Dr. Lodenir Karnopp) researchers from sign language linguistic area.

The advisory of a boy student from elementary education was performed by a specialized researcher in genetic and biotechnology contents. The Process of advisory has been closely followed by a psychology specialized in high skills/gifted children.

3. RESULTS AND DISCUSSION

The addition of educational/orange biotechnology definition in Wikipedia, the free online encyclopedia, in different languages (Russian, Portuguese, Spanish, Greek, French, Arab, Chinese,

Italian) was performed as described in methodology section and will be useful to spread this important subarea. We also added the content in English and German languages but we are still waiting for the release of the information online (Figure 1).

Figure 1: Examples of the orange/educational Biotechnology definition added on Wikipedia in different languages that are now found in GOOGLE search.

PORTUGUESE

Biotecnologia laranja ou educacional: tem como objetivo disseminar a biotecnologia e a formação nesta área. Ela desenvolve materiais e estratégias educacionais para dar acesso as informações sobre temas de biotecnologia (ex: desenho de organismos produtores de antibióticos) para a sociedade como um todo, incluindo pessoas com deficiências (ex: visual e/ou auditiva). Ela ainda busca estimular, identificar e atrair pessoas com vocação científica e altas habilidades/ superdotação para a área de biotecnologia

FRENCH

« Biotechnologie oranges » (d'intérêt Pédagogique, vise à diffuser la biotechnologie et développe du matériel éducatif et des stratégies sur les questions de biotechnologie (par exemple production de protéine recombinante) pour la société y compris les personnes ayant des besoins particuliers tels que ceux ayant une déficience auditive et/ou visuelle. I vise à encourager, identifier et attirer les gens à vocation scientifique et hautes compétences/capacités pour la biotechnologie.

GREEK

Βιοτεχνολογία πορτοκαλί (εκπαιδευτικά βιοτεχνολογία)
εφαρμόζεται για τη διάδοση της βιοτεχνολογίας και της κατάρτισης στον τομέα αυτό. Αναπτύσσει πολυεπιστημονική και διεπιστημονική υλικών και εκπαιδευτικών στρατηγικών που αφορούν θέματα βιοτεχνολογίας (π.χ.. Παραγωγή ανασυνδυασμένης πρωτεΐνης) προσβάσιμα σε ολόκληρη την κοινωνία, συμπεριλαμβανομένων των ατόμων με ειδικές ανάγκες, όπως τα άτομα με προβλήματα ακοής ή/και διαταραχές της όρασης. Επιδιώκει επίσης να ενθαρρύνει, να εντοπίσει και να προσελκύσει ανθρώπους με επιστημονικό προσανατολισμό και υψηλές ικανότητες/χαρισματικότητα για τη βιοτεχνολογία.

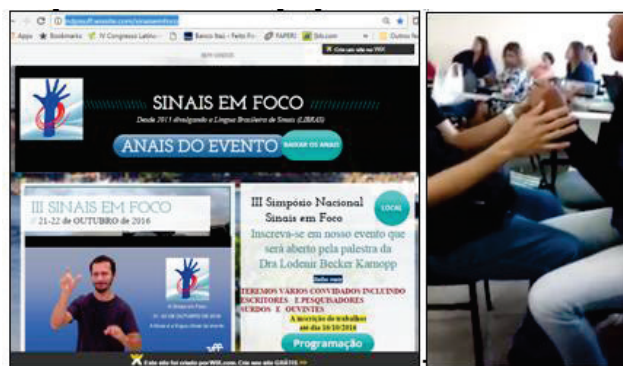
The event so called *International Meeting of Biological Biotechnological and Health Sciences* for all communities including deaf people (Figure 2) as well as the specialized Sign Language event named *Signs in Focus* (Figure 3) are described on Facebook and in <http://ndpisuff.wixsite.com/sinaisemfoco>, respectively.

Figure 2: Description of *International Meeting of Biological Biotechnological and Health Sciences* event on Facebook with specialists including in Sign language also using double interpreters (English to Portuguese and Portuguese to Sign language) to allow accessibility for deaf people to English lectures.



The spreading of Biotechnologies themes among other scientific and humanities contents for deaf people was performed by using Sign language interpreters including for deaf-blind people in the Sign in focus event (Figure 3).

Figure 3: Homepage of *Sign in Focus* event (<http://ndpisuff.wixsite.com/sinaisemfoco>) with specialists in Sign language and Biotechnology (Right) that offered interpreters for deaf blind people (Left).



The final strategy to catch young brains to biotechnology area in a Brazilian public schools was successful and a young kid of 9 years old is now enrolled in a scientific career in The Post-graduate program of Science and Biotechnology (PPBI) of Fluminense Federal University (Figure 4).

Figure 4: Presentation of the young boy of 9 years old about his research work produced together with the geneticist-biotechnological specialized advisor in PPBI Workshop.



4. CONCLUSIONS

The recognition and incentive of the Biotechnology educational subarea may help to create new and better strategies to spread and teach biotechnology, such as those reported in this work. This subarea may improve not only human resources formation but also products and processes production, which consequently might improve the future of our society

5. REFERENCES

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