

Luís, M. &, **Monteiro, R.** (2011). *Conceptual Progression Hypothesis study about asexual reproduction and germination in Plant Reproduction*. “World Conference on New Trends in Science Education”. Dokuz Eylul University, Izmir University and Pedagogical University of Cracow – Kusadasi. september 19-23, Kusadasi, Turkey.

**Conceptual Progression Hypothesis study about
asexual reproduction and germination in Plant Reproduction**

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Abstract

This work aims the understanding of how the conceptual progression on plants reproduction presents itself to the primary school students. Was made a exploratory study (Arnal *et al.*, 2001) to select three students for the instrumental case study (Stake, 2000) and performed in-depth interviews (Arksey & Knight, 1999). From the conceptions collected was built an Progression Hypothesis presented according to nineteen categories and three levels of conceptualisation. According to this progression hypothesis we were able to identify the obstacle in the learning process of the concept plants reproduction.

1. Introduction

The information presented in this document is part of a broader study in which we collected conceptions about plants reproduction, obtained through questionnaires and interviews. The conceptions were analyzed and classified in nineteen categories related with the associated issue. However, from the set of emergent categories only two of them will be presented in this article: Germination and Asexual Reproduction. The following analysis and the Progression Hypothesis here presented will afterwards be built from these categories.

2. Theoretical Framework

The previous ideas of students, as in the reasoning used by adults (including scientists) in daily life, are different from scientific thoughts (Driver, 1985). Student conceptions are egocentric, pragmatic and anthropomorphic (Santos, 1998). According to Kallery & Psillos (2004) in Byrne *et al.* (2008), they attribute human features to other life beings or inanimate objects and the universe is interpreted from the human point-of-view; it is the anthropomorphic and anthropocentric views of the world.

Studies developed by Osborne *et al.* (1992) about plants, shown from frequent answers given by students, that seed and apple are considered to be alive because they come from plants and in return plants are alive because they grow. Cañal (1997) show that children understand the plants respiratory system like an inverse process of animal respiratory system, i.e., they consume the carbon dioxide and they liberate oxygen.

The conceptual Progression Hypothesis (PH) is a landmark in the building of knowledge studies and serve guides the organization and sequencing of content (García, 1997). Therefore, to build a PH we progress from the simpler formulations to the more complex ones, until a more suitable or reference formulation is reached. In the work of

Cañal (1997) a learning progression of concept, from the daily knowledge to the scholarly knowledge in a gradation of formulation is shown, evolving from the real to the abstract. These features emerge also in the Porlán (1999), Pozo (1999) and Pozo & Porlán (2005) studies.

Conceptions emerge like obstacles to the own learning (Santos *et al.*, 1997) and the progression of the concept acquisition, i.e, if the incorporation of the new information to the previous one is not acquired a lack of cognitive connection between both will occur and the learning process will not be meaningful (Ausubel *et al.*, 1980).

3. Methodology

This research fits in a qualitative methodology of Denzin & Lincoln (1994). It is an interpretative study because we try to understand the phenomenon, searching for its meaning. According to Lincoln & Guba (1985) the research type is naturalistic because these realities cannot be isolated from their context and they must occur in the scenery or natural context of the studied identities.

The gathering of information was made from the exploratory study according to Arnal *et al.* (2001), with the introduction of questionnaires. This was followed by a case study according to Stake (2000) in Denzin & Lincoln, with the execution of interviews, answering three questions: (1) Which conceptions do students present about plants reproduction?; (2) How do the student's conceptions progress in scholarly knowledge building about plant reproduction? And (3) What are the obstacles which obstruct the progression of the student's conceptualization?

After the established PH, the obstacles of the progression were identified, i.e., what do the students lack or which conception do they have which prevents students from evolving their learning process (from the initial level to the intermediate level or from this level to the reference level).

4. Conceptual Progression Hypothesis (PH)

The students answers were analyzed by content analysis (Bardin, 1994) and after concluding this categorization, the PH was build according to García (1997).

In the Asexual reproduction category conceptions emerge in three PH levels, as presented in the Figure 1. In the initial level plants grow when they are cut.

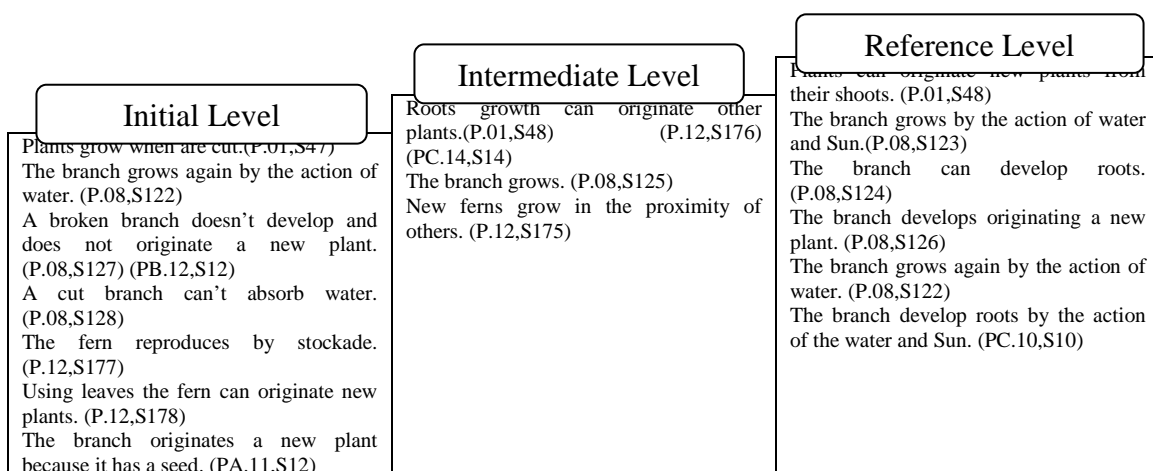


Figure 1 – Progression Hypothesis related with Asexual Reproduction category.

The branch “is constituted by seed, that’s why it works” (PA.11,1)¹ and the cut branch grows again because it absorbs water. The broken branch doesn’t develop and doesn’t originate a new plant because the cut branch can no longer absorb water, “(...) it can’t because it already doesn’t have roots inside the soil (...) (PB.12,1).

The obstacles to the progression into the reference level are the lack of knowledge about rhizome as a fern asexual reproduction structure (and not the root) and the non relation between a rose branch growth and their asexual reproduction, although recognizing it.

In the reference level, the branch grows by the action of the water and sun and can develop roots, emerging a new plant.

Regarding the Germination category, in the initial level the student ideas fits into an anthropocentric view of the world, according to Kallery & Psillos (2004) in Byrne *et al.* (2008). As shown in the figure 2, seeds like chick-pea, beans or corn, easily recognized as food in the daily universe of students, cannot germinate and originate new plants because their aim is closely related with their own feeding.

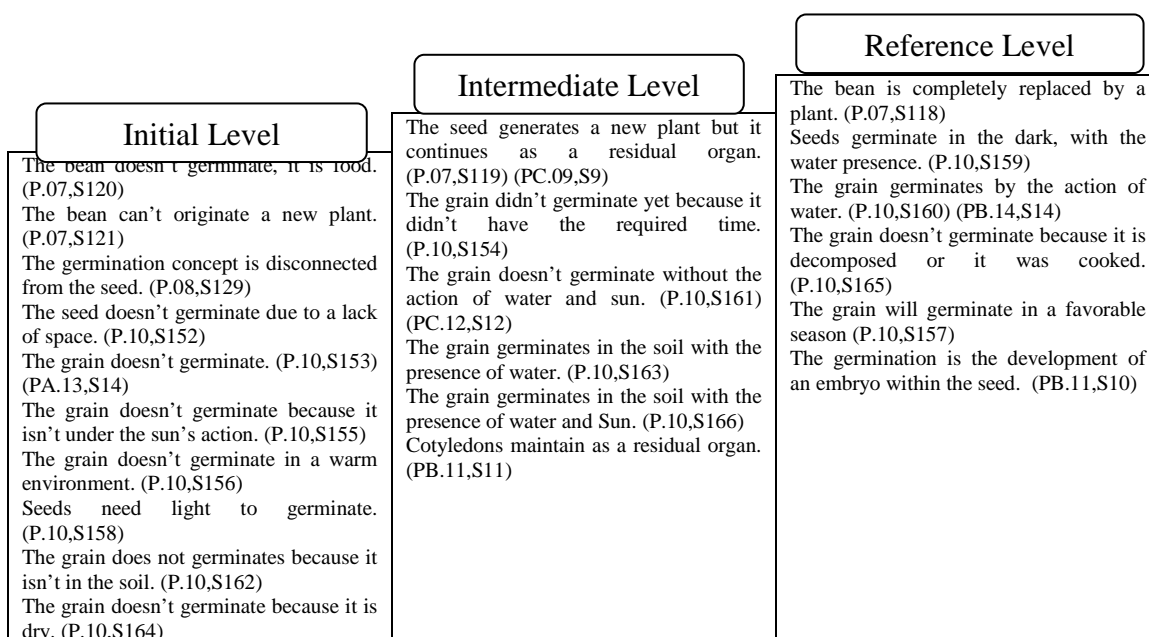


Figure 2 – Progression Hypothesis related with Germination category.

An obstacle to the progression into the intermediate level is the anthropocentric view of the seed, which is interpreted exclusively in a human perspective. There is also the idea that seeds need the sun to germinate. The lack of knowledge about the water importance in the germination is also identified as an obstacle.

In the second level we can find the conception that a seed originates new plants but they still maintain as a storage organ, as a female student refers:

“(...) I think that later on it would disappear (...)” (PC.09,1) or, in higher level, cotyledons maintains as a storage organ. For seeds to germinate, like a chick-pea grain, they need water and sun as the seed needs to be in the soil. The main obstacles to the progression are: not attribution to the cotyledons function of storage of nutritive substances, like in the Gonçalves & Duarte (1999) studies or in Cañal (1997) studies,

¹The codification presented here was made from an extensive research work called progression hypothesis in the study of a reproduction concept in plants”.

the lack of knowledge of water as a sole requirement and only condition to seed germination. Other facts like soil, sun beyond were also referred. In the reference level the embryo is distinguished by cotyledons, "(...) Here, I told, that bean 'broke' but it was the middle part (...)" (PB.11,2) and regarding its germination the seed is completely substituted by the plant. To germinate the seed only depends on water, and the germination would occur in the absence of light.

5. Conclusions

Although our conclusion on this research work was more extensive implicates mentioning other categories related to the reproduction of plants, we only present conclusions on two categories, Germination and Asexual Reproduction. Then the PH, previously presented, concerns these two categories.

In the initial level seeds used predominantly in the human food aren't recognized as seeds and because of this its germinal capacity is not attributed. On the other hand, the asexual reproduction has no expressivity in the students answer. In the intermediate level students recognize the growth capacity of a branch after the cut, growing and promoting the appearance of roots, but they don't know how it occurs.

About germination, a meaningful step is made when they assume that the chick-pea grain and bean can germinate but the water is not considerate the sole requirement and essential for this to occur. They don't recognize the part of the seed as they considerate the seed like a storage organ after germination.

In the reference level they identified that the seed parts distinguishes cotyledons from embryo. However they don't recognize the cotyledons function because they referred that cotyledon maintains in the soil as a storage organ.

These information's can be of good value in order to help the teacher have a vast range of conceptions between the students, regarding the reproduction theme. However, the emphasis of this investigation lies in the possibility of the teacher recognizing the obstacle in the progression of conceptions and that he/she can act upon it effectively, directing its education and promoting a meaningful schooling.

Acknowledgements:

This paper has been partially supported by the Portuguese Foundation for Science and Technology (FCT).

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