

“Extraterrestrial Intelligence” - Science Fiction Literature In Science Education: A Case Study

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ABSTRACT

This study refers to the research conducted with primary school students examining whether they can identify the ‘scientific context’ through analyzing science fiction short stories involving extraterrestrial intelligence. In addition, we examine whether they can write science fiction stories of their own using scientific elements in order to make their stories plausible. The research was conducted with a sixth-grade primary school class of 30 students over a period of five weeks in two-hour sessions during which students read and analyzed science fiction short stories and wrote science fiction stories of their own.

Our data (worksheets and science fiction stories by the students) were analyzed with Qualitative Content Analysis. Our analysis shows that the students are able to identify the elements of the text referring to the ‘scientific context’ and associate them with the literary context of the stories. However, the students find it difficult to integrate ‘scientific context’ in their own stories.

Keywords: *science fiction, extraterrestrial intelligence, science education*

INTRODUCTION

In this world transformed by technological, economic, and ecological changes, the role of literary culture seems more important than ever. This is a fact that is recognised as an imperative in the field of Science Education, as recent decades have seen an increase in sociocultural perspectives within Science and Environmental Education that are reflective of the cultural turn in intellectual theory more generally. These critical, historical, political, and socioecological views, interested in access to scientific knowledge, education, and power, have become part of enlightened Science and Environmental Education discourses (Carter, 2008). In this perspective, the gap between the sciences and the humanities and the urgent need to confront it, do not exist on the theoretical level alone. Indeed, we face an increasing number of situations that Bruno Latour, variously describes as ‘borderline’ questions or ‘sociotechnical’ and ‘ethicoscience’ imbroglios (Latour, 2003). These are intricately woven mixes that pertain simultaneously to the domains of the natural sciences and the humanities. Therefore, a sort of composite sciences-humanities literacy is required to help a democratic citizenry not only to scrutinize but also to contribute to science-and technology-based decisions about such imbroglios.

One way of investigating into these issues is through the literature of science fiction. With the genre’s license to create new societies and worlds, it seems an ideal tool with which to explore socio-scientific alternatives. Moreover, as science fiction is so often taken to be the expression of political opinion or ideology of the scientific and technological society aimed at presenting alternatives to social condition, it functions as thought experiment and critical discourse which can also bring more skepticism about politics, ideologies and epistemological certainties in the context of Science Education (Gough, 2006, Weinstein, 2006).

Science fiction is an ‘incubator’ for imaginative minds to create visions that help us to glimpse not only the scientific present and future, but also something about ourselves, and functions as the integrator of socio-cultural space that supports the dialogue between science and humanities. Yet more, science fiction is a genre well-suited to express the concerns about environment and explore humanity’s place in ecological systems since it encompasses a broad range of issues that derive from the interaction of humans with the natural world, and this literary genre’s articulations contribute significantly to the broad

rethinking of the relations between human and nature that is currently taking place specially in western societies (Merrick, 2005).

To bring science fiction into the science classroom is a way of “cross- fertilizing” the disciplines; yet these are precisely the sorts of things that can and should be done to open our students to broader intellectual perspectives. In reality, there is a great deal of overlap between the disciplines. The common thread that holds imaginative works and scientific works together is a celebration of the sense of wonder and awe that comes with addressing big questions about the nature of humankind and the universe our species inhabits (Brake *et al*, 2006).

Science fiction as creative and innovative literary genre addresses complex questions about our role in the cosmos which is both cross-curricular and invigorating, demanding a widening knowledge of various disciplines, drawing together the disparate strands of science and the humanities, and generating application to our modern world and its broadening horizons (Griffiths, 2009). Science fiction narratives (stories) are considered as highly valuable resources for Science Education (Negrete, 2003). Negrete and Lartigue (2004) suggest that narratives are indeed an alternative and an important means for science communication to convey information in an attractive, imaginative and memorable way. To present scientific information through stories should be regarded as an important means to transmit information in the repertoire of both science teachers and science communicators (Van Dijk, 2003).

Science fiction is often roundly criticized by scholars and educators as misleading (Michael & Carter, 2001), as a significant source of students’ misconceptions (Barnett *et al*, 2006) and sometimes as offering a distorted and stereotypical view of science and scientists, especially in science fiction films (Haynes, 1994:50-56; Thacker, 2005:140-142; Weingart, 2003). However, as science fiction can have a substantial impact on students’ scientific ideas (Barnett *et al*, 2006) as well as on their cultural response on science (Bates, 2005) it is important that teachers and science educators not only be aware of the ideas that are presented in science fiction but also be ready to confront this issue in science teaching in the classroom. (Jane *et al*, 2007). Therefore, rather than avoiding using science fiction in schools it may be a better strategy to engage students in the critique of science fiction (Barnett *et al*, 2006).

This Case Study refers to the research conducted with primary school students examining whether they can identify the ‘scientific context’ through analyzing science fiction stories involving extraterrestrial intelligence as well as the ethical, moral, political and cultural issues raised in the stories. In addition, we examine whether they can write science fiction stories of their own using scientific elements in order to make their stories plausible.

This study is a part of a wider research project whose main aim is to examine whether science fiction texts can be used as supplementary educational material in a cross-disciplinary approach between Science and Humanities in Primary School (Stavrou & Skordoulis, 2008; Stavrou *et al*, 2009).

In this Case Study we have chosen the “extraterrestrial intelligence” issue taking advantage of the intense interest that young students have in the existence of extraterrestrial life to introduce them with the multidisciplinary sciences, as this issue involves astronomy, life sciences, earth sciences, biology, chemistry, and physics problems associated with the question of the existence of life inside or outside our solar system (Brake *et al*, 2006; Griffiths *et al*, 2001; SETI, 2003). Moreover, students are given the opportunity, through the subject of “extraterrestrial intelligence” to confront controversial topics, such as ‘otherness’ and to deal with moral and ethical issues as well as perspectives about humanity’s situation in the universe (Griffiths, 2009; Saunders *et al*, 2004).

In the condition of the classroom the concepts of “difference” and “commonality” regarding “extraterrestrial intelligence”, could be a starting point in understanding how acts of meaning and interpretation, identity, and ending of subordination can share similar features. Recognizing the similarities in feelings, in counteractions, despite the sundry differences that students have with extraterrestrial beings, sets no determining direction or final outcome for social conflict. At best, the struggles and hopes supported by this point of view share a sense of community, dialogue, and intersubjectivity that bind peoples (SETI, 2003).

METHODOLOGY

Due to the fact that this study is part of a wider research project aiming at examining whether science fiction texts targeted at adult readers could be used in the context of educational process in primary school, we designed and conducted the following Case Study (Yin, 2003).

Case Study Protocol

Research Questions

- Whether students can identify the 'scientific context' and associate it with the literary context of a science fiction text.
- Whether students can identify the ethical, moral and political issues raised by the extraterrestrial intelligence issue.
- Whether students can integrate scientific elements into literary context in their own stories.

Sample

The research was conducted with a sixth-grade primary school class of 30 students (12 years old) of 16th Primary School of Athens, situated in the centre of the city. The majority of them came from low-income and middle-income families. Thirteen (13) of the students were children of financial immigrants, five (5) of which faced difficulties in understanding Greek language.

Our research consisted of five two-hour sessions which covered a period of five weeks. Over this period and during their physics lessons, we worked out the scientific viewpoint of extraterrestrial intelligence using magazine articles and the Internet.

Procedure - Implementation

I) Initially students were asked to answer a *Questionnaire*, which consisted of 4 open questions and 2 closed questions, in order for us to examine the students' perceptions of extraterrestrial intelligence as well as the students' knowledge of scientific inquiry concerning the subject. The questionnaire, in the context of the present study, was given to students as an introduction to the subject of 'extraterrestrial intelligence, therefore, it is not part of the conclusion procedure.

II) *Reading and analyzing the texts*: Thereafter, the students were presented with the following science fiction texts (stories) involving extraterrestrial intelligence and they were asked to study and analyze them, in order to reinforce their ability to examine, to associate and to justify both the scientific and literary elements in the text.

Science Fiction Stories

- "Report on Planet 3" (1959) by Arthur Clark (short story): Being a report of Martian scientists on planet Earth, yet containing the 'scientific assumptions' of earthly scientific community. It also addresses the 'what if' assumption of science fiction.
- "The Heavenly Host" (1975) by Isaac Asimov (short novel): Newly arrived on planet Anderson Two, just before Christmas, Jonathan, child from Earth, is warned about the dangerous native inhabitants, but an accidental meeting with one of the natives convinces him that they are friendly and peaceful. He devises ways to communicate with an 'alien child' based on shared feelings rather than conventional language.
- "Moby Quilt" (2001) Eleanor Arnason (short novel): The teaming of disparate species (squid-like aliens and humans) together to investigate the possible sentience of one another. At its core the story is essentially an exploration of different kinds of intelligence. In this story AI (Artificial Intelligence) has the role of benevolent mentor.

The above texts were chosen on the basis of the following criteria: a) they were written by acclaimed and awarded science fiction writers b) they refer to socio-scientific controversial issues c) the extraterrestrial beings are depicted in a positive way.

The textual analysis was based on the elements comprising the "scientific context" of the stories. The term "scientific context" refers to scientific concepts, scientific instruments as well as the authors' scientific assumptions. In these particular texts it is concerned with the planet's position in the universe (planet or satellite), the planet's conditions (the composition of the atmosphere, climate, its flora and fauna), the

references to scientific instruments, the extraterrestrial beings themselves and the ways of communicating with them as well as the authors' scientific assumptions.

Having read and analyzed each text, the students had to work on a *worksheet* on the 'scientific context' of the text, as well as the characters, their actions, the facts and the plot. The worksheets were designed in order for us to examine the students' ability to identify the literary elements, such as theme, plot, setting and conflict and associate them with the scientific elements of the stories, such as scientific concepts, instruments as well as the authors' assumptions. In addition, through the *worksheets*, we examined the students' ability to highlight any societal and /or ethical, moral and political issues raised by the extraterrestrial intelligence subject.

III) In the next stage, the students were asked to write their own stories in order for them to elaborate further on the issues presented. Even if they didn't manage to write a complete story, they were asked to come up with a plot outline and then discuss how "scientific context" would play a role in the story they envisioned.

The students' writing assignments were examined in the light of their references to:

- a. The way in which they used the "scientific context".
- b. The way in which they used literary elements such as plot, characters, setting and their assumptions of the theme of extraterrestrial intelligence and the way they associated them with 'scientific context'.

Our data (worksheets and science fiction stories by the students) were analyzed in accordance to "Qualitative Content Analysis" (Mayring, 2000, Krippendorff, 2004).

I) Worksheets: For each worksheet we established the following *categories* and *subcategories*

Category: Identification and recording of 'scientific context' of science fiction text.

Subcategories

Complete identification and recording of 'scientific context': worksheets containing complete identification and recording of scientific elements of 'scientific context' (scientific concepts, scientific instruments as well as the authors' scientific assumptions).

Adequate identification and recording of 'scientific context': worksheets lacking one of the aforementioned scientific elements.

Deficient identification and recording of 'scientific context': worksheets lacking more than one scientific elements.

Category: Connection of 'scientific context' with literary context.

Subcategories

Setting: worksheets in which the scientific elements are associated with the setting of the story.

Characters: worksheets in which the scientific elements are associated through the characters.

Plot ('scientific' assumptions): worksheets in which the scientific elements are associated with 'scientific assumptions' contained in the story line.

Conflicts: worksheets, in which the scientific elements are associated with conflicts, either these concern the characters or the plot.

Category: Ethical, moral, political and cultural issues

Subcategories

With reference to scientific research: worksheets that contain references to ethical, moral, political aspects of the scientific research presented in the text.

With reference to scientists: worksheets that contain references to ethical, moral, political aspects of the scientific community and scientists characters presented in the text

With reference to Human – alien encounter: worksheets that contain references to ethical, moral, political aspects of encounters between humans and aliens as presented in the text.

II) Science fiction stories written by the students

In order to analyze the science fiction stories written by the students we established the following *categories*:

Categories

Category: 'scientific context': stories in which students use scientific elements in order to make their story plausible.

Category: 'literary context': the literary elements of each story as setting, characters, plot.

Category: Integration of 'scientific context' with literary context: stories in which the scientific elements are associated with literary elements in order for the students to put forward their claims and reasoning.

The questionnaire was also analyzed with "Qualitative Content Analysis" but as we mentioned above, was given to students as an introduction to the subject because our study was conducted in class conditions.

RESULTS

I) Questionnaire

The scientific research concerning extraterrestrial intelligence.

As far as scientific research was concerned, 27 students mentioned NASA's and SETI's Projects, the radio telescopes as well as the Hubble space telescope, while only 3 of them mentioned, manned or not spacecraft missions.

Concepts and standpoints concerning extraterrestrial intelligence.

All the students held a firm belief in the existence of extraterrestrial beings. 25 of them claimed that there was extraterrestrial life in the solar systems of our galaxy or in other galaxies apart from ours. 21 of them considered the beings to have humanlike characteristics, including the ability to express emotions, and 19 of them believed that such beings possessed higher intelligence than that of humans.

Ethical, moral, political and cultural issues concerning scientific research for extraterrestrial intelligence.

16 students maintained that the scientific research for extraterrestrial intelligence promoted the advance and development of science and technology, while 18 of them believed that such research was carried out for the purpose of humanity's future colonization of other planets. Only 2 students believed that the research aimed at finding out the extraterrestrial beings' intentions concerning the earth.

II) Worksheets

- "Report on Planet 3":

Category: Identification and recording of 'scientific context' of science fiction text.

Subcategories

Complete identification and recording of 'scientific context'	28
Adequate identification and recording of 'scientific context'	2
Deficient identification and recording of 'scientific context'	-

Category: Connection of 'scientific context' with literary context.

Subcategories

Setting	30
Characters	30
Plot ('scientific' assumptions')	27
Conflicts	28

Category: Ethical, moral, political and cultural issues

Subcategories

With reference to scientific research	30
With reference to scientists	30
With reference to Human – alien encounter	30

All students mentioned and elaborated on the subject of the 'scientific context' of the text, as it refers to a Martian scientists' report on Planet Earth. Students could link the text's 'scientific context' with literary context when the former had reference to setting, characters and conflicts, whereas they were confronted with some difficulties to define the 'scientific assumptions' which were enunciated to the plot of the story.

- "The Heavenly Host":

Category: Identification and recording of 'scientific context' of science fiction text.

Subcategories

Complete identification and recording of 'scientific context'	29
Adequate identification and recording of 'scientific context'	1
Deficient identification and recording of 'scientific context'	-

Category: Connection of 'scientific context' with literary context.

Subcategories

Setting	30
Characters	30
Plot ('scientific' assumptions')	30
Conflicts	30

Category: Ethical, moral, political and cultural issues**Subcategories**

With reference to scientific research	30
With reference to scientists	30
With reference to Human – alien encounter	30

The majority of students (29 students) mentioned and elaborated on the subject of the 'scientific context' of the text (planet's position, existing life forms – means of communication with them) and all of them associated it with literary elements.

➤ "Moby Quilt":

Category: Identification and recording of 'scientific context' of science fiction text.**Subcategories**

Complete appreciation and recording of 'scientific context'	25
Adequate appreciation and recording of 'scientific context'	1
Deficient appreciation and recording of 'scientific context'	4

Category: Connection of 'scientific context' with literary context.**Subcategories**

Setting	25
Characters	30
Plot ('scientific' assumptions')	23
Conflicts	28

Category: Ethical, moral, political and cultural issues**Subcategories**

With reference to scientific research	23
With reference to scientists	28
With reference to Human – alien encounter	28

While analyzing this text, which was the most difficult of the three, some of the students (5 students) couldn't soundly identify the scientific elements (as Artificial Intelligence) and associate them with literary context. These were the students that found it difficult to complete the worksheets as well, and they were the ones that had difficulties in Greek language. Nevertheless, these students (5) did remarkably well in the first two stories.

In all three texts (stories) students were at ease associating the scientific elements with literary elements as well as raising the ethical, moral and political issues involved, especially concerning scientific inquiry as well as the scientists' role. It's worth mentioning that all students paid special attention to the colonization of other planets convention, which was mentioned in two of the texts, and according to which, humans do not have the right to colonize planets where there is intelligent life.

Science fiction stories written by the students**Categories****Category: 'scientific context'**

As far as the students' writing assignments (stories) are concerned, the "scientific context" was focused on the conditions of the planet (24) and the description of the beings (21), without however any effort on their part to associate the beings' appearance with the conditions existing on the planet.

Category: 'literary context'

Fictionally, their stories, mostly (29 stories) involving two characters - the child itself and an alien creature - were set on almost all occasions on another planet but earth, except one set on earth. The 'aliens' were always depicted as friendly beings that meant no harm to the human race and, most of the times (28 stories), were in need of help. The student protagonist, who in all of the stories held the role of a scientist, always prevailed without any evident conflict.

Category: Integration of 'scientific context' with literary context

The majority of students (29) failed to fully integrate the 'scientific context' in the 'literary context', in their stories, in accordance to science fiction conventions.

Ultimately, the students were eager to write a story and they took special care to present a piece of writing devoid of spelling errors.

CONCLUSIONS

Although the students were not familiar with written science fiction, they were at ease identifying, writing down the 'scientific context' of science fiction texts and making associations between the scientific and literary elements of a story, especially when presented with texts referring to subjects familiar to them.

Throughout the process the students were successfully motivated to get involved both in physics sciences and in fiction. In particular, the texts' reading as well as the worksheets, succeeded in arising all students' interest. Even immigrant students kept asking questions about definitions of unknown words. All students eagerly participated and managed to comprehend and process the "scientific context" and the literary elements of the texts. They also very easily processed the societal, ethical and moral issues raised concerning scientific inquiry, scientific community and human-alien encounter.

Because of their engagement with science fiction texts students were queried and discussed not only about scientific issues but also about social and scientific ramifications on finding intelligent life on another planet as well as human's role in the cosmos. Consequently, selective science fiction texts can be useful and effective teaching tools in Science Education.

REFERENCES

- Barnett, M., Wagner, H., Gatling, A., Anderson, J., Houle, M., Kafka, A. (2006). "The Impact of Science Fiction Film on Student Understanding of Science". *Journal of Science Education and Technology*, vol.15(2):179-191
- Bates, B. (2005). "Public culture and public understanding of genetics: a focus group study". *Public Understanding of Science*, vol.14:47-65
- Brake, M. & Griffiths, M. (2004). "Broad horizons – SETI, SF and Education". *International Journal of Astrobiology*, vol. 3(2): 175-181
- Brake, M., Griffiths, M., Hook, N., Hanis, S. (2006). "Alien worlds: astrobiology and public outreach". *International Journal of Astrobiology*, vol.5(4):319-324
- Carter, L. (2008). Sociocultural Influences on Science Education: Innovation for Contemporary Times. *Science Education*, vol. 92: 165-181
- Gough, N. (2006). Shaking the Tree, Making a Rhizome: Towards a nomadic geophilosophy of science education. *Education Philosophy and Theory*, vol.38 (5), 625-645
- Griffiths M. & Brake, M (2001) Artificial Intelligence, Artificial Life and Ethics. Science Fiction Research Association Conference May 2001, Schenectady, New York
- Griffiths, M. (2009). "Dress rehearsal for the future: why science fiction should be part of the curriculum". *LabLit.com. The culture of science in fiction and fact*.
- Haynes, R. (1994). *From Faust to Strangelove: Perception and Representation of Science in Literature and Fiction Films*. Baltimore-London, John Hopkins University Press
- Jane, B., Fler, M., Gipps, J. (2007). "Changing children's views of science and scientists through school-based teaching". *Asia-Pacific Forum on Science Learning and Teaching*, vol. 8(1), article 11
- Krippendorff, K. (2004). *Content Analysis: An Introduction to its Methodology*. Thousand Oaks, CA: Sage Publications
- Latour, B. (2003). Morality and Technology: The End of the Means. *Theory, Culture & Society*, vol. 19(5/6): 247-260
- "Life in the Universe": An Educational Project conducted by the SETI Institute with sponsorship from the National Science Foundation and NASA (2003).
- Mayring P.(2000). *Qualitative Content Analysis*, in "FQS", v1, N° 2 – June 2000, www.qualitative-research.net/fqs/fqs-eng.htm
- Merrick, H. (2005). "Alien(ating) Naturecultures: Feminist SF as Creative Science Studies". *Reconstruction: Studies in Contemporary Culture*, vol.5(4)

- Michael, M. & Carter, S. (2001). "The Facts about Fictions and Vice Versa: Public Understanding of Human Genetics". *Science as Culture*, vol. 10:5-32
- Negrete, A. (2003) Fact via Fiction: Stories that Communicate Science. Available at <http://www.pantaneto.co.uk/issue12/negrete.htm>
- Negrete, A. & Lartigue, C. (2004). "Learning from education to communicate science as a good story". *Endeavor*, vol.28(3):120-124
- Saunders, D., Brake, M., Griffiths, M., Thorton, R. (2004). "Access, Astronomy and Science Fiction: A Case Study in Curriculum Design". *Active Learning in Higher Education*, vol. 5(1): 27-42
- Stavrou, I. & Skordoulis, C. (2008). "Literature of Science Fiction in Science Education: as critical discourses for scientifically and politically literate citizens". Proceedings of the XII IOSTE Symposium, pp. 1031-1040
- Stavrou, I., Skordoulis, C., Halkia, K. (2009). "Science Fiction Literature in Science Education: An empirical study". Paper presented at International Conference of ESERA in Istanbul, Turkey.
- Thacker, E. (2005). *Genome and Biotech in Pop Culture*. Cambridge, Mass: MIT Press
- Yin, R.K. (2003). *Case Study Research: Design and Methods* (3rd ed.). Thousand Oaks, CA: Sage Publications
- Van Dijck, J. (2003). "After the 'Two Cultures': Toward a '(Multi) cultural Practice of Science Communication". *Science Communication*, vol.25, 177-190
- Weingart, P. (2003). "Of Power Maniacs and Unethical Geniuses: Science and Scientists in Fiction Film". *Public Understanding of Science*, vol.12(3): 279-287
- Weinstein, M. (2006). Slash Writers and Guinea Pigs as Models for a Scientific Multiliteracy. *Educational Philosophy and Theory*, vol. 38(5): 607-623

Science Fiction Stories

- "Report on Planet 3" by Arthur Clark (1959)
- "The Heavenly Host" by Isaac Asimov (1975)
- "Moby Quilt" by Eleanor Arnason (2001)