

***“Enough has yet to be said”*: Dialoguing neoliberal ideology, pedagogy, and subjectivity in science education**

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Responses

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Abstract

This paper endeavours to discuss further the pressing issue of neoliberalism (along with the accompanying realities of consumerism and globalization) and its pervasiveness in the field of science education. A number of recently published science education journal issues (CSSE, JRST and soon to be Science & Education) have significantly opened and exposed issues in science education concerning neoliberalism and consumerism in the context of globalization and global capitalism. This significant shift in the science education literature has brought forth diverse voices about/against neoliberalism along with different approaches to research in the field of science education. The goal of this paper is to contribute to this discourse by joining post-structural and pedagogical voices for change in science education. We discuss specifically the usefulness of the post-structural subject, some aspects of the field of science education, and the power of pedagogical approaches concerning neoliberalism in the form of dialogue. The authors, two doctoral students from Canada and Greece, bring forth both divergent and convergent perspectives and in doing so create new understandings between themselves regarding the relationships between neoliberalism, science education, pedagogy and post-structuralism.

Introduction

The main purpose of this paper is to explore different understandings concerning the relation(s) of science education to neoliberalism from the particular perspectives of post-structural theory and pedagogy. Encouraged by the recent special issues in Cultural Studies of Science Education (Carter 2011, Martin 2010) concerning neoliberalism, consumerism, and globalization, we came to the idea that clearly *“enough has yet to be said”*¹. This paper uses the literary technique of dialogue to discuss-four key themes: the context in which we decided to write this paper; neoliberal ideology; the post-structural subject; and challenges for science teachers. These themes have been discussed and argued by the authors for the last four months, either face-to face or via Skype™/e-mail. Combining our different perspectives of post-structuralism and pedagogy has both strengthened and challenged our understanding of the existing discourses, ideologies and challenges of neoliberalism and science education in our own contexts (Canada and Greece), and in the context of the ‘other’.

We, Anastasios Siatras and Jesse Bazzul, first met in Thessaloniki, Greece during the International History, Philosophy and Science Teaching conference in July 2011. The conference summer school

provided a forum for us to start a broad conversation concerning our recent work and future research interests despite the fact that we had very wide-ranging perspectives and background studies. The comradeship that was forged at the conference became a necessary component for us to engage in dialogue concerning many aspects of science and education such as student marginalization and the spectre of neoliberal ideology. Though we found ourselves generally *in simpatico* on a broad political level, which became a motive for even more dialogue, we also found that we had divergent perspectives and approaches as to how science educators can engage the pressing issues. Anastasios argues that the challenge against neoliberalism lies in a focus on pedagogy which provides a powerful space for resistance. Jesse holds that science educators need to (re)consider how we think about science at fundamental levels by considering the nature of discourse and ideology and its involvement in the constitution of subjects and subjectivities. While not wholly disagreeing or agreeing with one another, through dialogue, we have found new articulations for our own ideas along with new ideas themselves. We see our dialogue as a somewhat natural component of *metalogue* whereby interaction between scholars is facilitated through a discussion around a central topic (Roth and Tobin 2006, p. 3).

Tobin and Roth (2002) support the idea that co-authors who use metalogue interaction within their written texts gain the opportunity to retain their personalities by writing in first person, while also learning from the dialogical reflection (p. 269). In other words, metalogue provides not only the appropriate space for researchers to learn from one another, but a space for public debate and discussion by negotiating the boundaries of scholarship, not the 'identities' of scholars (Staller 2007, p. 155).

Moreover, the process of metalogue helps us to understand the difference between *doing* dialogue and *how or why* a dialogue should be done (Martin 2006, p. 698). A dialogue, within the context of metalogue, takes a critical position by bringing together researchers in order that they may benefit from the understandings of their peers, as can be seen in the metalogue written by Catherine Milne et al, 2008, as well as express their own understanding. In other words the necessary component of the dialogical action is the communication amongst researchers. In Paulo Freire's (1970/2005) words:

Dialogue, as essential communication, must underlie any cooperation. [...] Dialogue does not impose, does not manipulate, does not domesticate, does not "sloganize". This does not mean, however, that the theory of dialogical action leads nowhere; nor does it mean that [people do] not have a clear idea of what [they] want or of the objectives to which [they are] committed" (p. 168).

The dialogues in this paper focus mainly on naming what we both consider the most salient aspects related to engaging neoliberalism, global capitalism and consumerism. However, we do not hold that this dialogical reflection should be deprived of the action needed to engage neoliberalism in science education. The process of naming must be followed by the action of transformation of the world around us; in our case it

means continuing to change our practice in the field of science education, as well as advocating change in science education literature. In Freirean terms, “dialogue cannot be reduced to the act of ‘depositing’ ideas in another nor can it become a simple exchange of ideas to be consumed by the discussants ... it is an act of creation” (p. 89). Considering theory and practice in relation to dialogue, Freire maintains that their separation impoverishes the dialogue:

To do so would reduce theory to a pure verbalism or intellectualism. By the same token, to negate theory for the sake of practice, as in the use of dialogue as conversation, is to run the risk of losing oneself in the disconnectedness of practice. It is for this reason that I never advocate either a theoretic elitism or practice ungrounded in theory, but the unity between theory and practice. In order to achieve this unity, one must have an epistemological curiosity... that is often missing in dialogue as conversation” (p. 19).

We consider our dialogue as an act of resistance to more mainstream scholarship in science education as well as part of a praxis of forwarding more critical discourse in this field. Through our dialogue about neoliberalism and science education we feel we have definitely gained new insight into both neoliberalism and science education. Like Freire and Macedo (1987), we support the idea that “knowledge is not a piece of data, something immobilized, concluded, finished, something to be transferred by one who acquired it to one who still does not possess it” (p. 27).

Why are we writing?

Jesse: I think we are writing this paper as an extension of the pressing issues that came up during the IHPST conference. First, although stated at the conference often from another more conservative point of view, there is concern over the theoretical direction of science education. Second, like at the conference, everybody is still talking about Greece - meaning that I seriously believe our minds have been unable to tune out global economic crises!

Anastasios: Greece has been in the middle of the neoliberal tornado for 2 years now. The public and social wealth of the country is under attack! Essential public wealth is either in the process of selling (in the case of the public energy industry and public transportation) or is being shrunk (in the case of public health services, public education/schooling, social welfare, etc). Budget cuts in education are so pronounced that even students have started their school year without getting their textbooks by the Public Textbook Agency Publications. The Greek Ministry of Education hasn't even the outlay needed to print the textbooks. Thus, students started going to school without their books! This situation is still ongoing even now as I am writing this; one month after the school year has started. Having said that, the next thing I wonder is if the growing animosity toward neoliberal policy, which is increasing among the people day after day, will somehow be represented in the scholarship of science education in Greece. Having followed the discourses of science education in Greece, I think most of the Greek science education scholars not only ‘refuse’ to touch upon the field of neoliberal ideology, but also align their scholarships with the international apolitical literature.

Jesse: I like how you see science education literature as a natural extension of politics. I recall a session of our recent summer school where a ‘senior’ researcher told us that as graduate students we were lucky to be able to have a coca-cola with researchers at this particular conference ‘as if we were actually one of them’. I remember thinking ‘Wonderful, so at science education conferences I will either not be one of them or they will only pretend that I am’. It seems like there are thick blinders influencing the way many of us speak to each other in science education. Remaining oblivious to power and how it circulates in what is said and done maintains the discipline as it is (and maintains it quite well).

Anastasios: It's very interesting how you refer to the 'access to the scientific/academic world' of 'junior' researchers in terms of exclusion. It reminds me of something we have in my university as well as in many other universities, where we still keep the tradition of 'academic hierarchy' not only vertically (students, professors, dean, and rector, etc) but horizontally as well (different field of studies). For example, in the case of official ceremonies (not only in graduation ceremonies) all members of the Senate must wear a particular cap and gown with different signs and colours. The signs on the gown show the categories in the academic hierarchy to which one belongs (i.e. student, professor, etc) and the colour of the gown shows the field of science you belong to (i.e. black colour for social sciences, red colour for health sciences, etc). Thus, you can imagine how I feel as a graduate student in the field of pedagogy - last on a long list! However, for me the most interesting thing was that some of our colleagues at the summer school continued to enforce the same categorizations. I remember the endless debates we had about science education scholarship and their efforts to align their views strictly with their natural science background studies, while reminding others (me, for example) that they (I) do not have strong science backgrounds.

Jesse: I remember this tension about background education! Of course I had no idea of your educational background at first, I had just thought you were older somehow than the others! This question of power (and knowledge) is at the heart of any challenge to the status quo in science education. A good example of how power can be treated differently in the context of globalization can be found in the current special issue of JRST. While all the articles are relevant to science education it seems that some educators speak openly and clearly about the material conditions, oppressive consequences (for some and not others), and the historical and political contexts of globalization; whilst others are eager to speak about an unproblematic 'world community', the need for integrated international testing, and the 'pressures' that government policy makers face. What seems clear, and I think this is vital when speaking about and confronting neoliberalism, is that we are ready to speak of ourselves as framed by the effects of power. Only then can we begin to speak and act in ways counter to these effects.

Thinking about Ideology and Neoliberalism

To be sure neoliberalism is a complex economic and social phenomenon that deserves specific consideration in the diverse contexts in which it is manifests. However generally neoliberalism seems to embody the idea that human well being can best be advanced by freeing up entrepreneurial initiatives, private interests, and free markets (Harvey 2005). Going further, neoliberalism also comprises a complex political process for re-arranging and re-structuring social relations for the unfettered demands of global capitalism (Bourdieu 1998). It is this idiosyncratic (as opposed to commonsensical or inevitable) political project and its re-envisioning of educational institutions and relations that has become a central topic of pre-occupation, vitriol, and even wonder. It is vital for science educators who wish to push back and problematize neoliberal ideology in educational settings to think about ideology itself, how it operates and recruits all of us on a general level. Slavoj Žižek (2008) emphasizes that “the concept of ideology must be disengaged from the ‘representationalist’ problematic: ideology has nothing to do with ‘illusion’, with a wrong distorted representation of its social content” (p. 104). Ideology “is rather this reality itself which is already to be conceived as ‘ideological’ - ‘ideological’ is a social reality whose very existence implies the non-knowledge of its participants as to its essence” (Žižek 1989, p. 21). Žižek warns that in our ‘post-ideological’ age, with its ironic detachment, we are in danger of leaving untouched the fundamental level of fantasies that work to construct social realities themselves. The direct implication for science educators then is that we must never assume that we can talk about science and science education outside of ideology, for the very semblances science educators take for granted (institutional funding bodies, the priorities of scientific

research) are themselves also part of a social reality which is inescapably steeped in ideology - especially when educators find themselves not thinking fundamentally about how these things have come to be. According to Louis Althusser (1998), ideology operates first at the level of the institution (i.e. family or school) then at the level of consciousness; schools and their perceived neutrality, “naturalness”, or freedom from ideology is, for Althusser, an ideal ideological apparatus. It is this central point of “naturalness” that may be key for science educators to at least be aware of, if not somehow engage, ideology, as Althusser claims that it is the very denegation of ideology that comprises an important aspect of the character of ideology: “Ideology never says: ‘I am ideological’” (p. 118). In this way science educators can begin to engage (neoliberal) ideology whenever they, or others, claim to speak from outside of ideology. But how could science educators come to recognize moments, or take the time to recognize, when ideology is either most at work or most pertinent?

Concerning neoliberal ideology science educators can watch for whatever is given as natural, or commonsensical, such as the necessity of corporate influence and market logic in science education programs or science research agendas. What may be helpful is to consider Roland Barthes’ (1972) main principle of myth conceptions - “to transform history into nature” or obscure motive for reason (p. 140). Engagement with neoliberal ideology in this sense means watching for neoliberal values which are given as natural in science education - especially when applied to social relations and phenomena not considered part of the economic sphere. The painstaking role for science educators involves (re)historicizing and (re)politicizing a science education that claims (on a general level) to speak outside of ideology, and with a language of “common sense”¹. Michel Foucault (1972) maintains that ideology in relation to science must focus on precisely when science is taken up into discursive regularities and practices. Science’s marriage with capitalism, the corporate world and neoliberal values so that its products and very functioning are contingent on its relation to the common sense of business and market logic should echo loudly. Taking into account Shamur’s (2010) warning about ‘re-ifying’ ideas and/or having them become merely (commodity) signs, a perhaps unavoidable pitfall if one takes Baudrillard’s (1996) semiotic explanation of our current society’s ideology of consumption seriously, science educators who anchor their engagement with neoliberal ideology in material conditions and or examining the realities of social relations may find their efforts leading to more change possibilities². Here, it is our hope that interpersonal dialogue, where at the very least alienation from another is mitigated, can perhaps restore some kind of *attachment to the real*.

¹ The contentious nature of this statement for science education is perhaps best realized alongside Karl Popper’s (1972) statement that “all science and all philosophy are enlightened common sense” (p. 33)

² A heartening example of how science education can engage such materially based social relations can be seen in Richardson Bruna’s (2009) study where science education played a role in ‘proletarianizing’ students of rural Mexican backgrounds.

There are science educators who have made head-long attempts at disrupting neoliberal, corporate agendas and ideology in science education with more socially just and openly political frameworks for doing science (for example the *stepwise* framework, Bencze & Carter, 2011). One notable aspect that marks the work of scholars like Lyn Carter and Larry Bencze is that their pedagogy and education philosophies intend not to mask the political nature of science and science education but to bring the political nature of science, and their work, into the open. It is this type of political transparency that can allow science educators to say openly, and with conviction, that we speak from a position of ideology - the key point here being “so let’s speak of ideology”. And science educators can do so only if and when we also make a commitment to engage sociopolitical thought, a trend so far generally lacking in a field inundated with empirical study and semi-permeable disciplinary boundaries (Carter 2011).

(Neo)liberalism and social exclusion in education

Liberalism as an ideology in education has roots as far back as the late nineteenth century, where many conservative educational policy-makers in western democracies stated publicly that schooling for the working-class children could become a risk for the well-being of the upper-class (Cook-Gumpez 2006). In order to avoid that risk, educational reforms were carried out in all fields of education. In science education it meant reforming science curriculum from something that was more directly linked to the daily life of children having lower socio-economic backgrounds towards a program of study for the needs of the white upper-class males (Hodson and Prophet 1994). Science curricula became more compatible to the expectations of upper-class education which could afford – both financially and in terms of time in school – to acquire the knowledge of ‘pure’ science or rather the knowledge of the academic world of science (Hodson 1987). Thus, skills and competencies in [science] education were historically associated directly with the economic and social status of students individually (Soltow and Stevens 1981).

These days, the restructuring of capitalism creates new conditions which encourage the exclusion of children from education generally and from science education in particular. Jeremy Rifkin (1995) argues that modern capitalism is completely different from what we have known it to be so far³. The principles of traditional employment, the purchasing of goods and property ownership have been replaced by newly formed, more important, ideals such as the access to services; e.g., access to education, access to health services (Rifkin 2001). Tobin (2011, p. 129) notes that the ideals of neoliberalism, such as the individual freedom, consumerism and access to the public and social wealth (i.e. science education), are crystallized into a framework of opportunities which individuals *ought* to take advantage of. However, these opportunities are not essentially guaranteed to all people. Thus, those who can jump on that ‘wagon of opportunities’ have a chance of “progressing” in society and becoming informed individuals, while others who cannot follow current scientific developments are deprived of public, social, and even cultural wealth (Tsiakalos 2003). As Paulo Freire commented while he was discussing *the future of school*⁴ with Seymour Papert, success or failure to take advantage of opportunities is not a matter of the aptitude of children, rather it is a matter of guaranteeing or not guaranteeing equal opportunities to all. Within a neoliberal context, science education can be seen as a dual mechanism which preserves the power of elite groups over

³ One shift in the ‘new capitalism’ is away from what Max Weber (1958) described as a culture of re-investment and saving to one of rabid consumption (Baudrillard, 1998).

⁴ This dialogue took place in Brazil in the late 1980s. The transcript of the dialogue can be found at Papert’s website: <http://www.papert.org/articles/freire/>

others (see Fig. 1). On one hand, this mechanism allows students to participate in science courses by nurturing particular ways of thinking, formalizing decision making, and developing the context upon which future consumers must act in the world (Bencze 2008), while, on the other hand, it excludes from science courses children in poverty by not guaranteeing to all of them equal opportunities to access in social recourses (Calabrese-Barton 1998a).

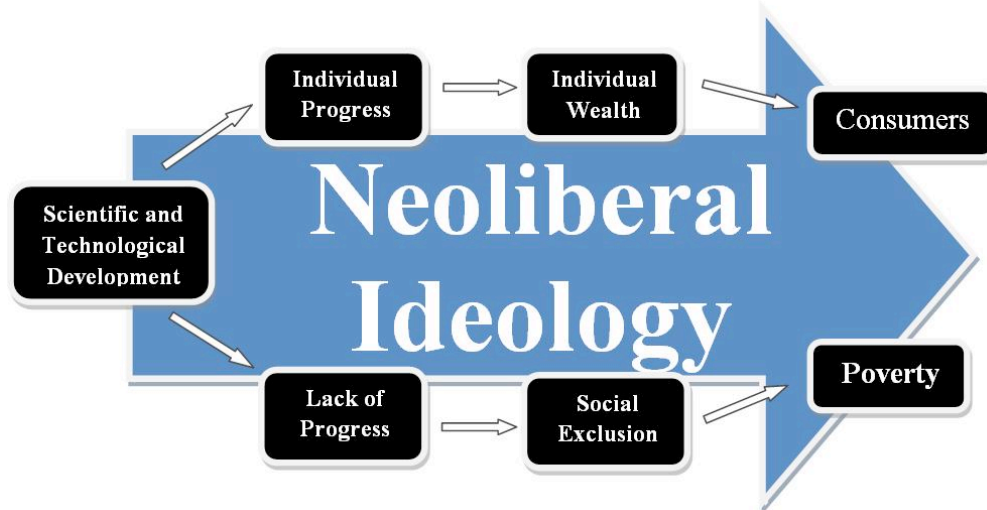


Figure 1: Scientific and Technological Development within a neoliberal ideology

For many years now, mainstream scholarship in science education has maintained a focus on scientific literacy (Roth and Calabrese-Barton 2004). Within this focus, scientific literacy is seen as a necessary component to stimulate communication between different cultures, foster the use of information and communication technologies (ICT) and to prepare informed individuals to make decisions as future citizens on contemporary social and environmental issues. Many skills were developed in the literature related to communication, critical and independent thinking, cooperation and teamwork, and continuous exchange of information and creativity, all of which showed a significant shift in science education in accordance with the shaping of our capitalist society (Apple 2011). Indeed, the PISA 2006 research, sponsored by the OECD, defines scientific literacy as the scientific knowledge which allows students to identify questions, acquire new knowledge, understand the features of science as a form of human knowledge, be aware of how science and technology shape our material, intellectual and cultural environments as well as to engage with science-related issues (OECD 2007, pp. 34-35). In other words, we could say that the scientific literacy is the knowledge all individuals need in order to deal with everyday issues in their life. However, the actual scientific literacy which individuals must acquire, is also interlinked with ideals of neoliberalism such as individualism, competition, and provision of opportunities (Tobin 2011, p. 128). Global organisations such as the Organisation for Economic Co-operation and Development (OECD) and the International Association for the Evaluation of Educational Achievement (IEA) have transformed scientific literacy, through their international assessment studies (PISA and TIMSS, respectively), into a ‘transformative’

rhetoric of quality of science teaching, access to resources, and equal opportunities of individuals to succeed in science courses (Carter 2007, p. 84).

As Lyn Carter (2009) notes scientific knowledge that is learner-centred and seemingly based on the progressive humanist tradition focuses mainly on pedagogies which implement social control in teaching and learning processes. In particular, she supports goals that are based on a concrete neoliberal view of the world such as: “a) intellectual freedom and autonomy, and creativity, [...]; b) democratic decision-making [...]; and c) a high degree of tolerance and flexibility to co-operatively engage in dialogue [...]” (p. 57), which have been communicated through education for many years now. However this neoliberal view transforms the political concept of democracy into an economic or consumerist concept which in turn redefines mainstream education as education for consumers (Apple 2006, p. 32). Many scholars have been insightful by criticizing neoliberal ideology in education and asking why socially excluded students continue to fail in school science despite equal access to educational resources that have been provided to them as well as equal opportunities to succeed in education. Angela Calabrese-Barton (1998b, p. 534) has emphasized that it is not only ‘equal access’ that has not been essentially guaranteed to all students, but students in poverty are also expected to change their whole life in order to be fit into the context of science which has always been given by dominant groups; thus marginalized students are excluded from active participation in science courses (Koumaras 2009).

Thinking About Ideology in Our Context

Jesse: The problem for me is this: How can we speak of things like neoliberal ideology in science education when we (science educators) do not often understand (or want to understand) how ideology can function? What seems to be required is something along the lines of academic or researcher risk-taking whereby different, more radical, forms of scholarship are attempted in the face of impersonal and discipline constrained peer-review; along with solidarity with our brave colleagues. Science Education of course is situated in a larger academic struggle; is the role of higher learning primarily to solve problems and meet the needs of those in power or is it to challenge and reformulate the fundamental ways we think about, and act, the world?

Anastasios: We definitely live in a ‘golden era’ of the development of radical scholarship in the field of science education. Someone may wonder: ‘golden era’ for whom? One answer I can give is of course for radical educators and in our case for radical science educators. However, thinking about more radical research in science education a couple of questions have been raised. For example, is there any differentiation among the newly developed literature concerning the so-called ‘radical science education’? I agree with you when you say that science education is the ‘battlefield’ wherein many academic struggles take place and I think this is due to the power that science education has in the process of forming our society. Indeed, I think Michael Roth⁵ couldn’t have stated it more correctly when he said that it is difficult to shape the metalogue of the mainstream science education scholarship. However, another question is: Are we ready, as radical (science) educators, to confront neoliberal ideology by presenting our own vision for the world? Do we really have a common vision of what we want? In other words: Have we stated clearly enough our own ideology by which we are driven to declare what kind of future society we want?

⁵ Tobin and Roth 2002, p. 274

Jesse: Those are very interesting and difficult questions. I sometimes feel it is easier to envision a better future from other dimensions of 'the left' (the way I see the left on a general level is simply those who align themselves on the side of the oppressed) such as anti-racism and radical feminism than it is to put forth alternatives to neoliberal and global capitalism. My guess as to why this is the case would have to do with the ability of these approaches to deal with notions like hybridity and uncertainty - in other words, they take into account in their very theorizing a postmodern 'reality'. I think it is significant to note that the major twentieth century alternative to capitalism (I know we are talking about neoliberalism) is now represented frequently in museums and theme hotels. Thus I think alternatives are hard to come by; but when they do come science educators must show solidarity either politically or in terms of large fundamental goals. Anastasios, you bring up a good point, what should/can we say about our own ideology?

Anastasios: Your interpretation about the left by using terms such as 'oppression', 'anti-racism', and 'radical feminism' shows a particular ideology. It is for sure that the left is not one common place for other left ideological perspectives such as radical leftists, communists etc. Particularly in Greece we 'suffer' from an ideological fragmentation of the 'left parties' which cannot unite against the neoliberal onslaught we are facing at this moment, but rather they seem to have turned against each other. For example, if someone were to search on Google scholar for the book 'The pedagogy of the oppressed' by P. Freire, which is one of the most cited books in radical education scholarship, (s)he will find out that this book returns almost 25.500 hits. However, terms such as 'left pedagogy' or 'pedagogy of the left' returned only 35 hits, despite the fact that Freire's work is being described within a broad context of 'the left'! I think the fragmentation of the left is one of the major problems we must deal with, especially in science education literature, in order that we may portray alternatives to neoliberalism and capitalism. The question is: Are we willing to follow that path despite the difficulties which lie ahead?

Asking-after Subjectivity in Science Education (Jesse)

Thinking about 'the subject' and subjectivity will likely lead one directly to the work of Michel Foucault. Succinctly, Foucault's work demonstrates how the various subject(ive) positions we take up are constituted by the specific possibilities of thought and action found within discourses where the inseparable essences and effects of truth and power circulate. It is often thought that that power is at the centre of Foucault's work, yet he states himself that "it is not power, but the subject that is the general theme of my research" (Foucault 1982, p. 209). This more "post-structural"⁶ conception of subjectivity challenges the unitary Cartesian subject, one that believes strongly in the subject's uniqueness of character and thought, as it has previously been taken up in various fields of the social sciences, arts and humanities. Quite understandably poststructural ideas of the subject have provoked fierce debates about human agency, for if our very subjectivity is constituted through discourse what hope do we have for change? For those who reject the idea of a discursively/ideologically constituted subject it can nevertheless be said that whatever idea of the subject we embrace the discourses that the subject must use are already *present* and at play (Foucault 1972). In this way Michel Foucault's notions of subjectivity are compatible with Louis Althusser's (1972) who maintained that subjects are *always-already* constituted through ideology (and ideological state apparatus), and that this happens *en masse* through state education. A more poststructural notion of the subject can allow

⁶ Post-structuralism is not to be thought of as a unified category of thinking. Best described it takes the search for orders, identities and forms that are maintained outside of history, irrespective of lived contingencies and claims all such things are strategies of power and ways of bending or constituting a particular reality (ex. for sociopolitical purposes) rather than understanding reality in clear orders of meaning (Rivkin and Ryan 1998, p. 334).

science educators to examine ways discourses in science education formulate the limits of thought and action. This includes the creeping influence of neoliberalism and global capitalist agendas in science education. Peter Ninnes (2002) has been successful in asking these kinds of questions in his work regarding space science and national politics in science textbooks as his inquiries are concerned with “the range of ideas” and “perspectives students can legitimately adopt” (p. 559). In Jesse’s dissertation work this notion of how discourses in science education curriculum materials work to constitute consumer, market oriented, neoliberal political subjects has yielded interesting preliminary results that demonstrate how science and its institutions can be oriented to principles of competition and corporate involvement. This paper will briefly develop the importance of the post-structural subject position from the perspective of feminist thinkers Judith Butler and Bronwyn Davies, as well as its broad application to asking questions in scientific inquiry. Feminism as a broad approach to knowing is perhaps indispensable when considering notions of the subject since the subject or agent of knowing in feminist terms is not monolithic or singular, this can stand in stark contrast to the “singular, Rational Man of Enlightenment Thought” (Harding 2006, p. 68).

In her essay, *Contingent Foundations*, Butler quickly addresses the critique that a unitary, free, rational, Cartesian - and thereby stable - subject is needed as the foundations of political thought (and by extension science). Requiring a particular definition of the subject position is in her terms “an authoritarian ruse by which political contest over the status of the subject is summarily silenced” (p. 36). Butler elucidates well a key point of the poststructural subject when she says:

“There is no ontologically intact reflexivity to the subject which is then placed within a cultural context; that cultural context, as it were, is already there as the disarticulated process of that subject’s production, one that is concealed by the frame that would situate a ready-made subject in an external web of cultural relations” (p. 46).

It is in the spirit of political and intellectual challenge that scientists, science students, and science educators can begin to question how their own subjectivities in the context of science education and inquiry has been constituted⁷. This view of the subject then may allow us to glimpse the power inherent in every context in which we work including the way we come to a “scientific” situation, opportunity or problem⁸. It allows us to interrogate how our fundamental views of what can be done, even thought, are formulated by theoretical positions, material conditions, along with what is excluded. It is the very constituted nature of the subject that is the pre-condition for radical change as Butler states, “for what is it that enables a purposive and

⁷ As Butler maintains this does not mean we can never say “I” anymore but that we “ask after” the processes of the subjects construction as well as its political meaning. This means not necessarily doing away with any version of the subject but to recognize the problematic nature of its formation.

⁸ Rasmussen and Harwood (2003) make the fine point that the subject is not whose recognition is induced by particular truths, but rather mechanisms of power and discourse that bring about the creation of the subject itself.

significant reconfiguration of cultural and political relations, if not a relation that can be turned against itself, reworked and resisted” (p. 46)?

If we are then *always-already* constituted as subjects before we enter science classrooms/labs/fields (and when we find ourselves there!) the kinds of questions we ask will also be contingent on these subjectivities. The key point here is not to assume, or for at least a moment suspend the idea, that we come to scientific inquiry with a unitary, free reasoning, subject position. If we as educators take the time to ask ourselves and our students questions that *ask after* the types of subjectivities we take for granted we can begin to work against the power discourse nexus that has already constituted what we may understand to be legitimate scientific inquiry. As Norris (2011) explains in regards to subjects and Jean Baudrillard, today’s subjects (students) are not free and rational, but are always-already caught up in the signs of consumerism. Subjects today have lost contact with the real world in the sense that what they today encounter (in the form of signs) does not itself refer often to something directly in the real world; in other words subjects are tuned into simulacra where signs now simply refer to other signs. In this way it is possible to both politically engage our own constituted selves and work against what neoliberalism, consumerism and global capitalism have fashioned us to take for granted.

It is not clear how much such a practice would be involved in science education, with its high levels of content, laboratory skills, not to mention its potential revulsion at the idea of a subject position whose rationality is questioned. However one desirable outcome that comes from questioning subjectivity is the opportunity to ask more questions. For example teachers and students can raise particular kinds of questions at some stage during science inquiry and also in regards to critical scientific literacy as described in many state curricula.

Regarding critical thinking the Ontario science curriculum (2008) gives the following description:

Critical thinking is the process of thinking about ideas or situations in order to understand them fully, identify their implications, and/or make a judgement about what is sensible or reasonable to believe or do. Critical thinking includes skills such as questioning, predicting, hypothesizing, analysing, synthesizing, examining opinions, identifying values and issues, detecting bias, and distinguishing between alternatives ... Critical literacy is the capacity for a particular type of critical thinking that involves looking beyond the literal meaning of a text to determine what is present and what is missing, in order to analyse and evaluate the text’s complete meaning and the author’s intent. Critical literacy goes beyond conventional critical thinking by focusing on issues related to fairness, equity, and social justice. Critically literate students adopt a critical stance, asking what view of the world the text advances and whether they find this view acceptable (p. 38).

Viewing our subject positions and subjectivities in science as constituted is congruent with the goals of social justice and the complex ways of looking at science found in critical scientific literacy, yet renders the above description(s) problematic. Since our very own subjective point of view has been constituted with the

truths and discourses already circulating science students and educators must also dig further into why in fact we have *come to understand* a particular situation and a ‘reasonable’ course of action. Seeing ourselves as constituted subjects means not fooling ourselves into thinking we understand situations “fully” nor can we necessarily ‘detect’ full bias or ‘distinguish’ between alternatives on a strictly rational basis⁹. Simply put, it involves dispelling simplistic understandings and asking questions such as: how did it come to be that we find a particular line of research or argumentation completely normal/rational/commonsensical?; What kinds of bias may be quite invisible to our results, initial brainstorming, research questions, or the way we identify values? In terms of engaging neoliberalism it means challenging the very realities of what we are told is central to science such as necessary corporate partnerships, scientific research being useful only as it aids the market, military research and even how science is ‘naturally’ competitive by nature.

Teachers may incorporate questions and discussions that challenge taken for granted subjectivities when they teach or practice some of the basic skills of scientific inquiry. Table 1 is based on the four areas of skills given in the Ontario curriculum and provides some suggestions in terms of how science teachers can begin to *ask-after* our particular subject positions and/or what we take for granted. Note there is nothing particularly poststructural about the questions themselves, but turning to a different view of the subject position may give more warrant for asking such questions.

Table 1. Skills associated with scientific inquiry (Ministry of Education, 2008) and questions that may disrupt taken for granted assumptions.

Skill Areas	Questions that challenge our own subjectivities
<i>Initiating and Planning</i>	In science education why are <i>these</i> particular choices for experiments, research or discussion presented over others? What alternative forms of research are sanctioned/silenced by those in power (teachers, bureaucrats)? If we were living in another society, time, place, or social position how might the research questions and ideas we’ve already formulated become different?
<i>Performing and Recording</i>	What kind of assumptions underlie our experimental procedures in terms of the object(s) of study? Who will the results of the inquiry benefit? What kind of worker is being constituted by this procedure?
<i>Analysing and Interpreting</i>	How do the conditions, context, and setting of this scientific inquiry formulate what we consider to be logical? Are their multiple interpretations and possibilities for the data?
<i>Communicating</i>	Who does and does <i>not</i> have ‘say’ in this research? Have we been given enough space to challenge this research? Is there a voice/author to our write-up/report? “Who” is this voice and what is it ‘saying’?

⁹ Lyotard’s (1984) somewhat prophetic predictions concerning the growth of efficiency and performativity, and our present day orientation towards them in matters of social justice and scientific truth strikes me as one starting point for this kind of questioning. How did it come to be that so much attention is given to efficiency and performativity across so many fields of scientific research? How have we come to think of these guiding principles as natural? Are their alternatives?

Those who take a post-structural view of the subject must not give overall primacy to one version of the constituted subject over another. Each constituted subject is contingent on the discourses, truths, and material conditions which give rise to a particular 'T'. Avoiding the over-simplified reification of any notion of the subject may mean viewing subjects as just contingent as the meaning of a photograph such as Roland Barthes (1981) describes in *Camera Lucida*:

“a photograph cannot be transformed (spoken) philosophically, it is wholly ballasted by the contingency of which it is the weightless, transparent envelope...it points a finger at certain vis-a-vis, and cannot escape this pure deictic language. That is why, insofar as it is licit to speak of a photograph, it seemed to me just as improbable to speak of *the* photograph” (p. 5).

Since subjectivity in individuals, like a photograph, is formulated by circulating discourses, truths, and specific material conditions/relations we must be careful not to pretend that we can define *the* subject; rather it may be better to focus attention on *a* subject. To ask after a subjectivity formulated by neoliberal discourse and ideology science educators need to engage with the very discourses, mechanisms of power, and material conditions that work to outline legitimate courses of action and rational thinking for neoliberal, consumerist subjectivities. Bronwyn Davies' (2006) work concerning power and the subject in education highlights a key tension concerning power in the classroom. First, while power is often exercised over those “only insofar as they are ‘free’” (Foucault 1994, p. 342), or believed to be free, freedom is always possible even when the power that constitutes subjects is invisible. For there is always something provoking a power relationship, and the suddenly reformulated will of those held in subjection. Regarding neoliberalism Davies emphasizes the importance of challenging this form of governmentality that claims that students have *no* choice but to work within the individualizing system of self responsibility and lack of care for others that exists currently. Asking after why we've come to find certain aspects of science in science education natural such as the necessity of corporate funding, individual achievement, and market oriented research can lead to new paths in research, inquiry, and social action. Asking after our very own subjectivity necessitates an integration of the sciences with history, literature, the arts, and sociopolitical thought. Yet, another reason for (science) educators to keep being engaged intellectuals!

Considering Subjectivity and the Role of Theory

Anastasios: First of all, I think it would be fair enough to say that I am not so familiar with post-structural ideas about 'the subject'. Thus, I have many questions about 'the subject' (or subjectivity) and your view about how we can challenge 'the subject' through science education by using post-structural ideas. My first question is: why do you think science educators want - in the first place - to question their 'identities' and the 'identities' of their students in science classrooms? Do you think that many of them are not comfortably settled in those 'identities'? I have met many science educators who tell me

“why are you doing research in this field (science and social exclusion) when we already know that science is not related to such things?” Do you think these science educators are ready to negotiate the power they have over students/learners?

Jesse: I think science educators are being made to see, on a daily basis, that issues of power, ‘identity’, and exclusion are unavoidable. Questions of oppression and how knowledge is imbedded in sociopolitical and cultural contexts have come (always!) already to the classroom. I am optimistic that there will be areas of overlapping interests amongst science educators such as the influence of consumerism in science education. Framing the usefulness of looking at subjectivity, in terms of questioning for example, may be helpful in finding common ground amongst diverse science educators as, overall, we may often be aching to ask the same questions. For example, why do we present particular sets of research priorities/experiment choices to students and not others? How does scientific research fit into the larger societal picture? At our recent conference I found letting more ‘traditional’ science educators know you are not making claims about just how important poststructural ideas are to science education puts everyone at ease. Besides poststructural explanations must always stress their contingent nature and should never be given as any kind of ‘definitive answer’ or ‘last word’ – much like the tentativeness of all scientific knowledge.

Anastasios: My concern is that we might be generally living, studying and planning our research activities within an ‘isolated’ progressive, left, or radical context. For example, in my university we have two schools of education (School of Primary Education [SPE] and School of Early Childhood Education [SECE]). In the SPE we study about the relation of social exclusion to education, critical science education, anti-racist and anti-sexist education etc, while in the fraternal school (as well as in the other 26 schools of education we have in Greece) graduates haven’t even heard of those terms, due to the conservative orientation of the faculty members of those schools. I am lucky to have had the opportunity to study in the SPE; however, I keep forgetting that we are, yet, only a few! If we move on to the field of science education - where we are even fewer - I think the situation becomes more difficult due to the power that conservative academic scholars have. Do you think those scholars could somehow be convinced about the importance of the post-structural ideas in questioning their own power? What do you think we should/can do about it?

Jesse: At my institution in Canada poststructuralism is somewhat mainstream - or at least it doesn’t surprise people if this is the type of thought that is ‘employed’. We do not have quite the same disciplinary divisions in education. So in a nutshell I would say that yes the mainstream in education is already using and will accept poststructural ideas – to what extent I am not sure. However, having said this it is not clear at all how well power is questioned in Canadian institutions. For example, after reading the work of Glenn Rikowski (2011), it seems that the very spaces that have become centres of resistance or challenge in education are themselves the investment of governments with the aim of producing competitive human capital for global markets - or one could say even constitute humans as capital! (something to think about the next time you come across “careers in science” lessons). In this sense change and resistance in regards to pervasive neoliberal discourses and practices fundamentally requires subversion of the very spaces in education we’ve come to inhabit. What is heartening is the unpredictable way power can be refocused back onto itself, producing quite unintended effects.

What Challenges Lie Ahead?

Anastasios: I think that the only way we could confront neoliberal ideology through education is to combine pedagogy with social and natural sciences! George Tsiakalos (2008, p. 21) is insightful by saying that pedagogy provides us with the necessary tools in order to portray a better world for all people. Having portrayed that world, social sciences help us to understand the particular circumstances which prevent us as society from moving towards that world. Last but not least, natural sciences help us to create the ‘material infrastructure’ of our vision for the future society. Of course, this is not an easy path to follow; on the contrary, we have to confront many challenges which lie ahead. However, within this paper, I think we’ve made a first step towards this direction by listening to one another and engaging in dialogical interaction.

Jesse: As far as neoliberalism goes, the greatest challenge, like all mythical understandings of the world that become commonsense, is just how far ideologies of efficiency, performance, and the market have become part of our daily thinking. For educators resistance must become a dual process of disruption and thinking whilst still endeavouring to act in the world. The difficulty can be summed up in (one of) Slavoj Žižek’s reversals of Marx’s famous phrase “They do not know what they are doing, but they are doing it” to “They know exactly what they are doing and they are doing it”. That is to

say, it is one thing not to be aware of ideology, but it is another to know of it, even despise it, but still behave as if we didn't know it. Thus for educators who are cynical of say the corporate world, it should be realized that we can still quite easily behave like ideological (neoliberal) subjects even while shaking our heads.

Anastasios: Reading over again this paper and rethinking our overall interaction reminded me of Paulo Freire's view that educators should be politicians (Freire 1978, p. 271). In our field it means science educators who intervene in the process of changing our society by promising a better world for all of us; in Bencze's (2010, p. 302) words: "[a world which] ensures that all students: are educated to the best of their abilities, develop more realistic conceptions of the nature of science and technology and their relationships with societies and environments, have the expertise and motivation to develop their own knowledge and are motivated and able to use their education for the benefit of the common good." This is exactly what I have learned from our dialogical interaction!

Jesse: To me this paper is extension of our attempt to think specifically about the question of neoliberalism (and in doing so we've conspicuously left out other dimensions of oppression such as race, sex(uality), etc.), as well as make sense of our specific locations within science education. I have found the process highly therapeutic and what is interesting to me is that our dialogue really does act like a subtext in the paper. I could not have predicted to any significant degree the content of our dialogue from the outset. Anyone reading should know that the two of us wrote online for hours every day over the last couple of months. Anastasios, while we kept complaining that we had other things to do, do you think we were actually in the space we really wanted to be?

"Enough has yet to be said"!

The focus of this paper has been neither to summarize the literature about/against neoliberalism, consumerism, and globalization in the field of science education nor to provide any definitive 'answers', but rather to highlight our personal understandings, as doctoral students, concerning the ways through which we can confront neoliberal ideology. The dialogues in this paper gave us an appropriate space to challenge our thinking and to ask questions about neoliberalism and science education. The impression that we both get through our dialogical interaction as well as writing this paper is that *enough has yet to be said*. What started as a dialogue in a small university hostel between two new researchers from two different contexts (Canada and Greece) became an exploration in how to deal with an ideology that has infiltrated all areas of social life. Despite the different directions we are pursuing in our doctoral studies (post-structuralism/ pedagogy and science education), and our divergent perspectives about confronting neoliberalism in science education, we both consider this paper a worthwhile attempt at re-forming our ideas, questions and concerns. What is certain is that writing and dialoguing together has brought new resolve and a spirit of cooperation that otherwise was not present before.

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