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Productive Discourses through the Integration of Out-of-school Media in Science Learning

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The use of out-of-school media (e.g., magazines, movies) in classroom teaching is often targeted at generating student interests towards the academic subject. However, there is much potential in using out-of-school media to foster disciplinary and critical literacy of the subject. A science curricular programme that we have designed and implemented was to juxtapose and compare students’ self-selected out-of-school media with traditional school-based texts. With data taken from a research study with a class of high school physics students in Singapore, this paper illustrates the quality of discourses produced by the students as they went through the programme. Through a discourse analysis on selected students’ work and interviews, this paper analyses how students made connections between physics and the content they identified in their chosen media. In particular, evidences of the students’ active processes in connecting everyday and scientific discourses are shown and discussed. These processes demonstrate learning outcomes that go beyond mere understanding of science content knowledge to an awareness of the disciplinary norms of scientific knowledge. They also demonstrate the kind of productive and critical discourses that could emerge from a curricular approach of juxtaposing and integrating out-of-school media in school-based science learning.
1. Introduction

The use of out-of-school media such as movies, newspapers, video games and Internet sites is a common strategy to engage students' interest in the learning of academic science. In the USA, a commissioned paper by the National Academy of Science (Rockman et al., 2007) concluded that "the media are the most pervasive disseminators of informal science education". Research in this area has also highlights a positive relationship between out-of-school media and student motivation and engagement in science learning (e.g., Falk, Donovan, & Woods, 2001). Although out-of-school media is seen as a positive contributor to the learning of science, the integration of media in formal school curriculum is largely confined within several boundaries. First, the use of media are mostly based on educators' assumptions of mainstream adolescent interests (e.g., soccer, crime investigation) rather than ethnographic studies of actual students' personal interests situated in their local communities. Second, most educators see out-of-school media as providing a source of information aligned or misaligned with institutionalised content standards and neglect the critical literacy element of discerning the varying socio-political agenda of out-of-school media. These gaps exist in both in research studies as well as classroom practices within science education.

As an attempt to address these gaps, a curricular intervention that uses a different approach in harnessing out-of-school media for science learning was implemented in this study. The key element in this curricular intervention was to have individual students brought self-selected out-of-school media to the classroom and compare them with traditional school-based texts and media. Through this intervention, it was found that out-of-school media have the pedagogical potential in fostering disciplinary knowledge and critical literacy of the subject matter other than the predominant thinking of generating student interest in the subject. In particular, the kind of discourses generated by some students was found to be of a nature unlike what had been observed in most science classroom discourses.

In this paper, I begin by outlining the theoretical and pedagogical perspectives that inform this study. This is followed by a description of the curricular intervention undertaken in the study and the methodological procedures in the collection and analysis of data. The learning outcomes and processes from two students are then presented. For the purpose of this study, I use discourse analysis to show the nature of the discourses generated by these two students as they related their out-of-school media to the disciplinary knowledge and practices of physics.

2. Theoretical Perspectives

The theoretical basis of this study is informed by research in New Literacies, which is characterised by a broadened view of literacy and media and their roles in the contemporary classroom (Leu, O'Byrne, Zawilinski, McVerry, & Everett-Cacopardo, 2009). A central view in New Literacies is the framing of literacy as forms of social practices unique to the "Discourse" (with a capital D) of a particular sociocultural community (Gee, 1996). Discourses are manifested in characteristic patterns in the way we speak, write, think, act, and use various media in our everyday practices. These ways of interactions are deeply embedded in our membership and participation in various communities, and learned through our habitual ways of interacting with people, tools, and media in those communities (Lave & Wenger, 1991). Thus, New Literacies research provides the theoretical insight that sees learning through media not as a matter of decoding/encoding information, but as a form of enculturation into the discourse communities that produce and use various media as part of their social meaning-making practices (Street, 2003). As such, the incorporation of popular
media in a science classroom should not be seen as an individualised learning of a
decontextualised form of knowledge, but as a larger interaction between two or more
Discourses. From these perspectives, I conceptualise a classroom as a physical, cultural, and
semiotic space where the Discourses of multiple social communities converge through the
interaction of the various participants (e.g., students, teacher, researcher) and the respective
media they bring.

Furthermore, the focus of incorporating out-of-school media is not about the information
embedded in the media, but rather on the opportunity that can be generated by creating a
contrasting juxtaposition with school-sanctioned Discourse in a classroom setting. The
ensuing conversation between contrasting Discourses is what researchers call a “third space”
(e.g., Gutierrez, Baquedano, & Tejeda, 1999; Moje et al., 2004). Deriving from Bhabha’s
(1994) cultural theory, the notion of a third space has recently been used in education in
constructing an “in-between” cultural space jointly negotiated among multiple (sometimes
competing) Discourses brought into the classroom. Barton and Tan (2009, p. 52) define a
third space as one where different Discourses “coalesce to destabilise and expand the
boundaries of official school Discourse.” This occurs when multiple cultural practices in
different discourses are deliberately juxtaposed to be mutually challenged, integrated, and
transformed so as to generate new forms of understanding and literacy practices (Moje et al.,
2004). It is argued that a third space would provide a rich setting for learning as the students
navigate the various Discourses that are brought into the classroom.

In order to create the conditions for a third space to evolve, I further draw on the pedagogy of
multiliteracies to inform the design of a curricular intervention for this study. Multiliteracies
was developed by the New London Group (1996) with the goal of responding to the shifting
nature of literacies in a rapidly changing political, economic, and technological world. The
pedagogical framework of multiliteracies is based on an integration of four factors: situated
practice, overt instruction, critical framing, and transformed practice. Situated practice begins
with a meaningful immersion in the learners’ knowledge and experiences. This is relevant to
the incorporation of the students’ out-of-media in the curricular intervention. Situated
practice is then followed by an overt instruction to help students connect their out-of-school
media and the knowledge associated with it to academic science learning. The purpose of
overt instruction is not only to meet curricular standards and benchmarks, but also to
facilitate the development of critical framing, which involves understanding that all forms of
disciplinary knowledge are points of view shaped by particular combinations of language and
representations under certain social, historical, and political influences. In this way, critical
framing helps students interpret the social and cultural context of different texts and
constructively critique them. Eventually, critical framing allow students to creatively extend
the texts to produce new ones of their own in new contexts, and this is the end goal of
transformed practice.

3. Methodology

Informed by the theoretical notions of third space and multiliteracies as described earlier, a
curricular intervention was designed and implemented in a high school physics programme in
the following manner:
1. Situated practice – Each student selected an everyday media artifact related to his/her personal interest and a physics topic (e.g. mechanics, electricity). The type of media selected by the students includes a range of videos, websites, articles on news, and magazines. The phenomenon embedded in the media became a personal context for the student to explore and learn about the physics concepts or principles behind the phenomenon.

2. Overt instruction – From the personal context, the student then identified a question about an interesting phenomenon from his/her chosen media and then wrote a scientific explanation for this question using physics knowledge and language learned in school.

3. Critical framing – The student also had to write a critical evaluation of his/her chosen media in terms of the accuracy, reliability, bias and/or simplicity of the information that was presented in the media.

4. Transformed practice – The student presented his/her explanation and critical evaluation through a glog, which is a form of digital poster (see http://www.glogster.com). By creating a space for students to juxtapose their out-of-school media with an academic form of scientific explanation and evaluation, the completed glog signifies a hybrid product created through the convergence of in- and out-of-school Discourses.

The above curricular intervention was implemented as a year-end physics project for a cohort of 231 physics students studying in a junior college (JC) in Singapore. These students have all completed the first year of a two-year GCE A-level physics programme. The implementation of the project was carried out in collaboration with six physics teachers from the JC. Out of the cohort of students, 53 students (33 boys and 20 girls) were invited to participate in the research study aimed to examine the process of their learning as they went through the designed curricular intervention. These students were purposefully selected by their teachers according to a maximum variation sampling strategy (Patton, 2002) in the following categories: (1) gender, (2) physics test scores, and (3) students’ interests and hobbies.

The research question in this study was: How do students connect the in- and out-of-school Discourses that were juxtaposed in the curricular intervention? In particular, the four factors of multiliteracies – situated practice, overt instruction, critical framing and transformed practice – were used as an analytical framework to divide the research question into the four respective components. Data collection consists of student interviews, students’ artifacts (e.g., media selections, glogs) and videos of lectures and tutorials during the enactment of the curricular approach. For the findings reported in this study, the data comes primarily from the interviews with the students and their completed artifacts (i.e., glogs). There were two semi-structured interviews with the selected students at the beginning and end of the physics project. The first interview was conducted to find out more about the students’ interests and how they made connection between their interests and the physics concepts they have learned in school. The second interview was conducted after the students had completed the project which required them to present their explanation and critical evaluation on their chosen media. This interview aimed to unpack the learning process and the steps taken by the students in completing their projects.
4. Analysis and Finding

For the purpose of this paper to illustrate the quality of discourse that can be generated through the juxtaposition of out-of-school media with school-based texts, I present two instrumental case studies (Stake, 2000) to provide insights on how students connect the in- and out-of-school Discourses that were brought into the classroom. Due to the contextual nature of the analysis, my purpose is not to make universally generalisable claims about the learning with out-of-school media nor evaluative statements about the success of the enacted curricular intervention. Rather, it is to gain a deeper insight into a pedagogical possibility that warrants further research study and educational investment.

The first case study comes from a male student called Shen, who is an avid fan of Fringe – an American television (TV) series about a group of government agents who investigate unexplained events related to a mysterious parallel universe. He has been watching every episode from the series since he was twelfth years old. In a particular episode selected by Shen for the project, the event revolves around how an electromagnetic pulse (EMP) bomb triggered the death of a human being. From this episode, Shen identified the following question for him to investigate in the curricular project: Can the victim be killed by an EMP bomb? The following is an excerpt from Shen’s explanation in his glog:

In the “Fringe” video, a victim had been exposed to an electromagnetic bomb. It is suggested in the video that this bomb reseted her electromagnetic charge in her body. This causes all the charge in her body to move faster hence killing her. This leads us back to our physics related phenomenon about force on a moving charge. However, in this case, it is the bomb creating a strong magnetic field that causes the moving charges in a human body to move abnormally.

In accordance with the first stage of the enacted curricular intervention (situated practice of multiliteracies), Shen situated his learning in his interest of science fiction. In particular, an episode from one of his favorite science fiction TV series heightened his curiosity on EMP and thus led him to find out more about it. Because the curricular intervention requires students to make a direct connection to a physics concept they had learned (a form of overt instruction of multiliteracies), Shen related what he heard from the TV episode about “electromagnetic charge” to what he was currently learning in physics about “force on a moving charge”. As he referred to his lecture notes, he revealed in the interview how he came to deduce that in order for the EMP bomb to “create a strong magnetic field”, it should comprise a solenoid (a coil of wire):

Yah, cause what I know right is the bomb is mainly just strong electromagnetic field so the only way, one of the ways we learnt in JC is the solenoid. So maybe it could be a solenoid in the EMP.

In his glog, he reproduced a schematic diagram of the solenoid based on what he saw in his lecture notes (see Figure 1).
From this deduction, Shen then went on to postulate how the solenoid in the EMP could upset the human body. This is where he related to his biology knowledge where he had learned that the nerve system in the human body contains charged particles in motion (see Figure 2 for a biology textbook’s diagram reproduced in Shen’s glog). By making these connections, he concluded in his glog that:

This leads us to the conclusion that due to the upward force, it causes acceleration in the charged particles. This causes the charge to move faster in the human body hence solving the solution of how it killed our victim in “Fringe”.

By synthesizing these connections, Shen was actively generating new knowledge that was beyond what he had learned from GCE A-level physics and biology. In fact, while Shen was searching on the Internet about the EMP bomb, he suspected that the information is classified because he could not find much information about it. As a result, he revealed that he had to develop “some theory of my own” about how the EMP works. This was where he came out with his “own theory” that the EMP bomb must contain a solenoid and a large amount of electrical charge in order for it to work. As we will subsequently, he later went on to test his theory by making some calculations based on the formulae he was taught.

Having explained how the EMP could theoretically kill a person, Shen did not stop at this conclusion in his glog. As required in the critical evaluation of the curricular intervention (informed by critical framing of multiliteracies), he went on to check the feasibility of the
EMP bomb killing a human being. To do so, he realised that he had to make some estimation based on several physics formulae he had learned. In his glog, he calculated what would be the electromagnetic force acting on a charge particle in the human body and noticed that it is numerically insignificant. Thus, he inferred that the EMP bomb as portrayed in the *Fringe* episode “may not be workable because of the high amount of energy needed”.

According to Shen, checking the feasibility of an idea is a prerequisite part of checking its reliability. He made the distinction between feasibility and reliability as follows: “Feasibility is theoretical whether it can work. Reliability is for the *Fringe* video to see whether they are lying or whether they are stating some correct facts or not.” Thus, based on his calculation, he concluded that the Fringe video is not reliable because the idea is not feasible. This led him to write in his glog:

> This source may be deemed unreliable as the science may stretch beyond facts so as to attract the audience attention towards the TV series. Hence, the electromagnetism discussed in the video may be a little far from its actual scientific theory.

Shen’s example illustrates a characteristic of critical literacy where he evaluates the reliability of a source in his out-of-school media exposure. Furthermore, it also demonstrates his awareness that in order to check the feasibility and thus reliability of a scientific argument in a source, he needs to carry out a certain disciplinary practice employed by scientists, which is to make estimations based on known formulae. This illustrates what the New London Group (1996) calls the meta-language awareness of using certain linguistic or representational practices in the critical framing of scientific knowledge and disciplinary norms.

In sum, Shen’s juxtaposition of the various texts (e.g., *Fringe* video, physics lecture notes, biology textbook) as he completed his blog illustrates a possible outcome that resulted from an in-between space (i.e., third space) of multiple Discourses converging in the classroom. Through this convergence, Shen was able to make good connections between his out-of-school media and what he learned in school physics. Furthermore, the juxtaposition also allowed him to critique knowledge from one Discourse using the knowledge and disciplinary practices of another Discourse. In other words, a transformed practice (last stage of multiliteracies) has taken place whereby he looked at a science fiction genre through the lens of a scientific genre.

The second case study comes from a female student called Salima, who is interested in martial arts. During the curricular intervention, she chose a particular documentary series from the History Channel called *The Human Weapon*. In this documentary, she became interested in a Ninjutsu move called a Hamukai. As she wanted to find out more about the physics behind a Hamukai, she framed the following question for her project: What are the factors that contribute to executing a good Hamukai? The following is an excerpt from Salima’s explanation to this question in her glog:

> In executing a successful Hamukai, several factors were taken into consideration. The factors are moment, force and energy. Moment is the product of the force and perpendicular distance about a pivot. In this movement, the elbow can be seen used as a fulcrum. Therefore it will also act as a pivot.
Similar to Shen, as a form of situated practice, Salima situated her learning for this project in her interest on martial arts. From the overt instruction in the curricular intervention, she then drew a connection between Hamukai and the physics concepts of "moment, force and energy". As shown in the above excerpt, she began by identifying the relevant "factors" from physics that account for the Hamukai move and giving a definition of the physics concept of "moment". She then correctly made the bridge between the position of the opponent's elbow (personal context) and the location of the pivot (a physics term), in doing so, she was able to explain the effect caused by the Hamukai. She further explained it during an interview as follows:

So using moment itself, it's force times the perpendicular distance. So the further away you are from target, since force and perpendicular distance is involved in the duration of moment, so if let's say the distance is constant, so if you put in more force to actually execute this move, it will result in more moment and thus more pain at the affected area.

In making her explanation, Salima referred to her lecture notes in mechanics during the project as seen from this excerpt from the interview:

For me, I took time in actually trying to find out or see the concepts that can actually relate it to the moves that's executed in this video. So I actually will flip through my notes, my physics notes, to actually see what concepts are actually related to this video.

When it comes to the critical evaluation, Salima differed in her approach as compared to Shen. Whereas Shen examined the reliability of the Fringe video by checking the feasibility of its scientific idea, Salima evaluated the reliability by checking the background of the author and the purpose of the video. Thus, she wrote the following in her glog:

The History Channel is a US-based international satellite and cable TV channel owned by A&E Television Networks. It originally broadcast documentary programs and historical fiction series since 1995. It has broadcast many television shows that are beneficial to users. Therefore, it a reliable source for information which makes this video from Human Weapon a reliable one.

Compared to Shen, Salima's evaluation may not seem to demonstrate a meta-language awareness of checking a scientific claim by using some forms of science disciplinary practice such as numerical estimation. This could be attributed to a major difference in the genre between science fiction and science documentary, whereby the ideas found in science documentary tend to be less far-fetched compared to science fiction. Thus, this makes it more difficult for students to critique the feasibility of those ideas. Nevertheless, Salima's evaluation is still a crucial form of critical literacy in checking the author's background and the intended purpose of the media source.

In sum, Salima's juxtaposition of the science documentary and her physics textbook illustrates another example resulting from a third space of multiple Discourses converging in the classroom. Like Shen, Salima was able to make some connections, both affectively and conceptually, between her out-of-school media and what she had learned in school physics. While she was not able to critique the knowledge presented in the out-of-school Discourse to the extent demonstrated by Shen, the juxtaposition of The Human Weapon video presented
her with the opportunity to develop the habit of critically examining out-of-school media that are related to science.

5. Conclusion and Discussion

From the analysis, Shen’s and Salima’s cases illustrate the learning outcomes and processes that occurred during the enactment of the designed curricular intervention, which was based on the theoretical notions of third space and multiliteracies. While Shen’s case was more exceptional, Salima’s example was somewhat representative of the 53 students who participated in the research. From these examples, we saw how out-of-school media were used in the curricular intervention to foster both science content knowledge and critical literacy, in addition to generating students’ interests in the subject matter.

Furthermore, we also saw two characteristics of productive discourse that emerged through the juxtaposition of out-of-school media and school-based physics texts. First, both examples illustrate there was an active generation of knowledge through the mixing of different language and ways of knowing. In Shen’s case, he generated new knowledge that went beyond what he had learned in school as he conjectured the making of a killer EMP bomb and further tested its feasibility through the use of physics principles and calculation. For Salima, she was able to apply what she had learned about moments to a novel situation related to her personal interest in martial arts. The second characteristic of productive discourse is a meta-language awareness and critique of different social ways of constructing knowledge. This was most evident in Shen’s case where he learned that in order to check the feasibility of a science argument presented in out-of-school media, he had to use a certain disciplinary practice employed by scientists, which is to make estimations based on known formulae. In Salima’s case, while she did not develop this meta-language awareness, she learned to evaluate the source of an out-of-school media by checking on the source’s authors and intended audience.

In this preliminary study, I have focused on the process of how students connect the in- and out-of-school Discourses that were juxtaposed in the curricular intervention, and used two instrumental case studies to illuminate this process. The next stage of the study will investigate, using the same data, the extent of how much the students were able to connect the in- and out-of-school Discourses during the curricular intervention. This will involve a more systematic coding that will be developed from this qualitative case study. This will be useful in evaluating the effectiveness of this curricular intervention that aims to develop disciplinary knowledge and critical literacy of science through the use of out-of-school media.

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7. References


