Assignment One: Practice & Pedagogy

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Assignment Title:

Physics 40S Curriculum: Using Media Literacy to Decode the Hidden Messages of the Curriculum

1. Connect your pedagogical tool to one of the Manitoba provincial curriculum. Outline and explain how your learning tool connects to specific elements of the curriculum documents (quote/reference the document directly).

The pedagogical tool I have designed is for the Physics 40S classroom. General Learning Outcome (GLO) A4 for this curriculum states that the students should "[i]dentify and appreciate contributions made by women and men from many societies and cultural backgrounds toward increasing our understanding of the world and in bringing about technological innovations". As a GLO, it is a concept that is to be consistently touched upon and nurtured throughout the teaching of this course, offering the students a broad perspective on the Physics 40S subject matter. The Physics 40S curriculum, however, only ever uses white male scientists in its examples, explanations, and descriptions. This is not only a stark contradiction to the goal of GLO A4, but it sends a damaging subliminal (or perhaps, overt) message to the students about who really "belongs" in the world of physics. The fields of science, technology, engineering, and math (S.T.E.M.) are overwhelmingly lacking in diversity, and my future students have a chance to change this unfortunate reality. My pedagogical tool will help them uncover the lack of diversity within the Physics 40S curriculum via a scientist audit and will challenge them to research and explain why this lack of diversity exists and what message it sends. Further, they will be required to create a poster which outlines a scientist who they believe is deserving of a place within the Physics 40S curriculum (or, in other words, who has been omitted), where in the curriculum the scientist fits and why, and why the student believes their scientist has not received the attention they deserve (what cultural/social/political/economic barriers existed/exist to prevent them from being mentioned in the same realm as the white male scientists of the historical and/or present world). They will be required to present their posters to the class, and in doing so, will inform the rest of us of the important contributions made by a diverse group of scientists. This will ultimately demonstrate that "white" and "male" are not prerequisites to becoming a great contributor to the world of S.T.E.M. and will truly satisfy GLO A4, and outcome that I believe to be as important as the Specific Learning Outcomes listed in the document.

2. Outline and explain how your learning tool exemplifies theories of media education. In this section, you will draw on the theories/theorists of media education. You can pull in readings beyond the course, but you should demonstrate engagement with the course readings.

In reading Chapter 4 of Hoechsmann's *Media Literacies: A Critical Introduction* there were so many concepts of media education that jumped out at me with respect to the Physics 40S curriculum and the tool I am proposing. Specifically, though, the four categories in Richard Johnson's heuristic for analysing media felt like they were directly applicable in the following ways:

<u>Cultural Life</u>: As stated on page 67 of Hoechsmann's book, "[social reproduction] relies on the broader discursive traditions of historical legacies and requires the real-life experiences of social actors to reproduce itself." Further, "the media might be best thought of as a distorting

mirror, one that reflects back to a society and culture many of the values and ideologies in circulation in that society." (Hoechsmann, p.67). These phrases represent important lessons that will be learned by the students in completing this assignment. In analyzing who exists within the curriculum, who does not, and why, they will come to better understand the values and societal norms of societies-past (and present!), and in recognizing that these old-fashioned values are being propagated through the "modern" physics curriculum, they will come to appreciate how media can play a role in social reproduction.

Production: The Physics 40S curriculum suffers from a negative position of enunciation, which will become clear to the students. Its "work carries with it the residue of previous representations. Past representations create the ground from which new expressions can be made. But, then, these new expressions always retain or implicate the history from which they develop and from which the artist or producer speaks." (Hoechsmann, p. 75) As the students will discover, the curriculum has not been modernized to include a diverse range of scientists. After coming to this somewhat unsettling conclusion, they will be given the opportunity to become the "producers" of new knowledge. In researching a scientist who they feel should be included in the curriculum and creating an informative poster, they are taking the media production process into their own hands and propagating knowledge that they believe better reflects the values of our own time.

Text: This pedagogical tool forces the students to engage in both content analysis and semiotics somewhat simultaneously. They will be asked to go through the Physics 40S curriculum in groups of two and to write down the name of every scientist that is mentioned. They must then analyze these scientists to determine any "trends or patterns that suggest what values or biases are being propagated." (Hoechsmann, p. 79). In doing this analysis, they will be applying the ideas of denotative meaning versus connotative meaning, i.e. all of the scientists are white men (denotative) and this sends the message that anyone outside of this description cannot be a scientist (connotative).

Audience: In completing the activities outlined in the "Text" section above, the students will then engage in cultivation analysis, and the goal is that they come to the same conclusion as cultivation researchers: "Cultivation researchers have found that the media tends to propagate and maintain political values already in circulation, hence serving to reproduce social order" (Hoechsmann, p. 87) and "cultivation analysis allows us to agree that, yes, the media does affect the young people in our classrooms; they do have attitudes cultivated by media exposure." (Hoechsmann, p. 88) In identifying the connotative messages held within the curriculum, they can then consider the impact this message has on students of the grade 12 physics class, and on the S.T.E.M. population.

In short, one of the main reasons behind the creation of my pedagogical tool is outlined perfectly by Abraham P. DeLeon in the conclusion of his article *Beware of the 'Black' Ripper! Racism, Representation, and Building on Antiracist Pedagogy:* "These critical conversations and analyses need to occur to begin the dialogue about how racist representations can be challenged and eventually dismantled." (p.6) In the case of my pedagogical tool, the students will be considering how racism, prejudice, and sexism are present in the curriculum, but in completing their posters and having discussions as a class, we will start to challenge what has long been accepted as "the norm".

3. Create a one-page student handout that outlines the objective and instructions of the activity/assignment. This should reflect the curriculum, grade and theories of media education.

Please see page four of this document.

4. Create an example of the activity/assignment for your students.

Please see pages five to nine of this document, plus the file A1LiaWright_Poster.png.

Physics 40S Curriculum: Using Media Literacy to Decode the Hidden Messages of the Curriculum

In the Physics 40S curriculum, General Learning Outcome A4 reads as follows:

GLO A4: Identify and appreciate contributions made by women and men from many societies and cultural backgrounds toward increasing our understanding of the world and in bringing about technological innovations.

The question is, in its current format, does the curriculum succeed in helping us to achieve this goal? The purpose of this assignment is to use your media literacy skills to analyze the curriculum in terms of culture, production, and content, and to consider the implications these elements may have on our student audience. In groups of two, you will take control of your physics education by doing the following:

1) **Preliminary consideration:** Who developed the physics curriculum and for what purpose?

2) **Create a List:** Create a list of all the scientists who are included throughout the curriculum. Your list should include each scientist's name, along with 3-5 pertinent details about their identity (ex. gender, age, country of origin, race, era/date of birth, contribution to current understanding, etc.).

3) **Analyze the Patterns:** Analyze your list and identify any patterns of inclusion/exclusion.

4) **Selection of a Specific Exclusion:** Through the inclusion of those who fit the trend, identify a group is excluded and research cultural/societal/economic/etc. reasons for their exclusion.

5) **Statement of Impact:** Explain the denotative and connotative meanings behind your findings, explain the message sent to the curriculum's audience, and state the impact you believe this has on diversity in physics. Based on the patterns you identified, do you think that the curriculum meets GLO A4? Explain.

6) **Take Charge of the Medium:** Select a scientist who, according to what you described in (4), has been excluded from the curriculum. On a poster, outline their name, their achievements, the reasons for their exclusion, and where you believe they should be included in the Physics 40S curriculum. Implement various media literacy codes to enhance the messaging of your poster (ex. colour, typography, background, page layout, etc.), and be sure to consider and include the larger societal impact of the inclusion of this person.

7) **Present Your Findings:** Posters will be shared during an informal gallery walk in the classroom. Students will learn from them and can consider the societal impact of including each of the highlighted scientists in the curriculum.

Part 4 of Assignment 1: Sample Project

1) **Preliminary consideration:** Who developed the physics curriculum and for what purpose?

The Government of Manitoba – specifically the area of Manitoba Education, Citizenship and Youth – were responsible for the development of the *Senior 4 Physics: A Foundation for Implementation* document. The outcomes listed in the document are based partially upon both the *Common Framework of Science and Learning Outcomes K to 12* (created by the Government of Canada) as well as the *Pan-Canadian Science Framework* of 1997. The main goal of the curriculum is to develop scientifically literate citizens, and the document states on page four of its introduction that students should "discover the significance of science in their lives and come to appreciate the interrelatedness of science, technology, society, and the environment."

In looking at the "Acknowledgments" section on page III, and more specifically at those tasked with the writing (Principal Writer and Contributing Writers), advising (Physics Education and Curriculum Advisor), and development (Members of Development Team) of the Physics 40S curriculum, we see that everyone was employed by either a university or government education program or a school division within Manitoba. Of the fourteen people listed, twelve are men and two are women; however, other than their work location, we do not have any further information about them and why they, in particular, were selected as contributors to the curriculum.

2) **Create a list:** Create a list of all the scientists who are included throughout the curriculum. Your list should include each scientist's name, along with 3-5 pertinent details about their identity (ex. gender, age, country of origin, race, era/date of birth, contribution to current understanding, etc.).

		Scientist					
Topic No.	Topic Name	Name	Gender	Year of Birth	Country of Origin	Race	University /Higher Education
1.2	Dynamics	Sir Isaac Newton	Male	1642	England	Caucasian	Cambridge
1.3	Momentum	Sir Isaac Newton	Male	1642	England	Caucasian	Cambridge
1.4	Projectile Motion	Carl Friedrich Gauss	Male	1777	Germany	Caucasian	Göttingen
1.5	Circular Motion	Sir Isaac Newton	Male	1642	England	Caucasian	Cambridge
1.6	Work and Energy	Robert Hooke	Male	1635	England	Caucasian	Oxford
		James Prescott Joule	Male	1818	England	Caucasian	Edinburgh, Oxford, and Trinity College Dublin
		René Descartes	Male	1596	France	Caucasian	Poitiers
		Gottfried Wilhelm Leibniz	Male	1646	Germany	Caucasian	Leipzig

2.1	Exploration of Space	Johannes Kepler	Male	1571	Germany	Caucasian	Tübingen
		Galileo Galilei	Male	1564	Italy	Caucasian	Pisa and Padua
		Edwin Hubble	Male	1889	U.S.A.	Caucasian	Chicago and Oxford
		Tycho Brahe	Male	1546	Sweden	Caucasian	Copenhagen
		Nicolaus Copernicus	Male	1473	Poland	Caucasian	Krakow, Bologna, Padua, and Ferrara
		Isaac Newton	Male	1642	England	Caucasian	Cambridge
		Henry Cavendish	Male	1731	England	Caucasian	Cambridge
2.2	Low Earth Orbit	Isaac Newton	Male	1642	England	Caucasian	Cambridge
		Jean-Domenique Cassini	Male	1625	Italy	Caucasian	Bologna
		Walter Hohmann	Male	1880	Germany	Caucasian	RWTH Aachen and Technische Universitat Munchen
2.3	Electric and Magnetic Fields	Charles Coulomb	Male	1736	France	Caucasian	École royale du génie de Mézières and Collège des Quatre-Nations
		Robert Andrews Millikan	Male	1868	U.S.A.	Caucasian	Oberlin College and Columbia
		Hans Christian Oersted	Male	1777	Denmark	Caucasian	Copenhagen and Technical U. of Denmark
		J.J. Thomson	Male	1856	England	Caucasian	Manchester and Cambridge
3.1	Electric Circuits	Benjamin Franklin	Male	1706	U.S.A.	Caucasian	N/A
		Stephen Gray	Male	1666	England	Caucasian	Cambridge
		Gustav Kirchhoff	Male	1824	Prussia	Caucasian	Konigsberg
		Georg Simon Ohm	Male	1789	Germany	Caucasian	Erlangen-Nuremberg
		James Prescott Joule	Male	1818	England	Caucasian	Edinburgh, Oxford, and Trinity College Dublin
3.1	Electromagnetic Induction	Emil Lenz	Male	1804	Estonia	Caucasian	Dorpat
		Nikola Tesla	Male	1856	Croatia	Caucasian	Graz and Charles
		Michael Faraday	Male	1791	England	Caucasian	N/A
		Thomas Edison	Male	1847	U.S.A.	Caucasian	The Cooper Union
4.1	Medical Physics	Niels Bohr	Male	1885	Denmark	Caucasian	Copenhagen, Manchester, and Cambridge
		Henri Becquerel	Male	1852	France	Caucasian	École Polytechnique
		Christian Doppler	Male	1803	Austria	Caucasian	Vienna Polytechnique Institute and U. of Vienna

3) **Analyze the Patterns:** Analyze your list and identify any patterns of inclusion/exclusion.

In auditing the curriculum for scientists, I found that 29 different people were mentioned. For each scientist, I chose to research their gender, year of birth, country of origin, race, university/higher education, and in doing so, certain trends became apparent. The following section identifies these trends, as well as the broad categories of scientists who were omitted from the curriculum because of these trends.

Gender: 29 out of 29 scientists were male, thereby *completely omitting the female gender and other gender types from the curriculum*.

Year of Birth: All 29 scientists were born between 1473 and 1889. In other words, they were born anywhere from 448 to 132 years ago. This means that *all scientists who were born less than 132 years ago have been omitted from the curriculum*.

Country of Origin: Of the 29 scientists, 24% were born in England, 17% were born in Germany, 10% were born in France, 14% were born in the U.S.A., 7% were born in Denmark, and one each were born in Prussia, Poland, Austria, Croatia, Estonia, Italy, and Sweden. All countries mentioned, with the exception of the U.S.A., are part of either Northern, Western, or Eastern Europe. *This means that scientists from outside of Europe and U.S.A. have been omitted from the curriculum.*

Race: All 29 scientists mentioned in the Physics 40S curriculum are Caucasian. *This means that all non-Caucasian scientists have been omitted from the curriculum.*

University/Higher Education: 27 of the 29 scientists attended some form of post-secondary school, whether it was a university, a college, or multiple universities and/or colleges. *This means the curriculum omitted anyone who did not attend/have access to post-secondary schooling (lack of access due to gender and/or economic factors).*

4) **Selection of a Specific Exclusion:** Through the inclusion of those who fit the trend, identify a group is excluded and research cultural/societal/economic/etc. reasons for their exclusion.

In considering the different omissions listed above, I am choosing to look further into the exclusion of female scientists from the Physics 40S curriculum. As noted, the male scientists who *were* included were born anywhere between 1473 to 1889. For the sake of analysis, let's ask the question: "Why were no female scientists who were *born during that same period of time* included in the curriculum?" The answer to this leads us to discuss the culture, societal beliefs, and economy of the times.

To begin with, women were not widely welcome to attend university in the above-listed countries until around the 1880's, i.e. the same decade in which the youngest of the 29 scientists was born, but even then, they were not admitted to science-related faculties. Generally, "curriculum was designed to train women in 'the arts and graces of life'" (Gaskell, p. 2), preparing them for the role of wife, or perhaps if they were lucky, school teacher or nurse. The article *Here's How Women Fought for the Right to be Educated* does a good job of describing the societal beliefs/norms with respect to women's education in bygone euro-western eras:

> "Women's pursuit of an equal, in-depth, high-level education as adults has met many stumbling blocks over the centuries: inferior standards (or the complete absence) of education for young girls, beliefs in women's intellectual inferiority, and worries that education in non-domestic subjects wouldn't adequately prepare women for their 'natural' role as wives and mothers."
>
> (Thorpe, 2017, p.2)

Essentially, the society of the time felt that women were suited to procreate and take care of the home, but not much else. If a woman had strongly desired higher education, it could have been attained through money and tutors, but the vast majority of women did not have access to either.

We also must take into consideration the fact that, until quite recently in history in Europe and North America, women did not have the right to vote, did not have the right to their own bank accounts, and were certainly frowned upon if they ever contradicted a man in an intellectual capacity. While female scientists *did*, indeed, exist between 1473 and 1889, you can imagine that it would not have been deemed appropriate for them or their scientific successes to be celebrated in the record books.

Knowing that the Physics 40S curriculum was published in 2005, however, begs the question as to why women scientists of the previous century (at the very least) were not included. Afterall, an entire section of the curriculum is devoted to medical physics, an area that was propelled forward by the Nobel Prize winning research of Marie Curie in the early 1900's, and then further advanced by her Nobel Prize winning daughter, Irène Joliot-Curie, thirty years later (note: these are just two of many examples that could have been included). Taking into consideration all the patterns identified in part (4), it is clear that the creators of the Physics 40S curriculum chose to simply reproduce the same euro-western meanings of both "scientist" and "history of science" that have existed for literally hundreds of years. Due to the complete lack of diversity or updated examples of physics-related discovery, it appears there was no attempt to modernize the curriculum in a way that would reflect the goal of a more inclusive scientific world.

5) **Statement of Impact:** Explain the denotative and connotative meanings behind your findings, explain the message sent to the curriculum's audience, and state the impact you believe this has on diversity in physics. Based on the patterns you identified, do you think that the curriculum meets GLO A4? Explain.

The connotative message that can be pulled from the curriculum is that scientists are white men from Europe. The denotative message being quite starkly delivered is that anyone who is not "white" and "male" is not and cannot be a scientist. This message is hugely damaging to the students' impression of who belongs in the world of science, technology, engineering, and math (S.T.E.M.) and its impact is directly exhibited in the make-up of Canada's S.T.E.M. graduates each year. According to Table 1 in a study by Kristyn Frank released by Statistics Canada in 2019, of a sample of nearly 50,000 S.T.E.M. graduates, only 30.2% were female, while 69.8% were male. Further, only 25.2% identified as a visible minority, while 74.8% were not visible minorities. These statistics can be extrapolated to apply to the types of S.T.E.M. teachers that students are seeing in their schools, thereby propagating the myth even further that one must be "white" and "male" to be good at S.T.E.M. topics. This is extremely problematic, and only through diversity in both the curriculum and in S.T.E.M. representatives can this start to change.

Further, the highly educated nature of each of the scientists mentioned in the Physics curriculum implies that "real" physicists go to post-secondary (or maybe multiple post-secondary institutions). This sends the subliminal message that to excel in physics, you must come from a part of society that can afford to attend prestigious universities. This, unfortunately, is not a reality for many students, and it can impact their belief in themselves regarding a future in this exciting topic, thereby shifting their focus to non-S.T.E.M. subject matter.

I do not believe the curriculum successfully achieves GLO A4. Again, it states: "Identify and appreciate contributions made by women and men from many societies and cultural backgrounds toward increasing our understanding of the world and in bringing about technological innovations." As demonstrated through the scientist audit and the identification of damaging patterns within the curriculum, the curriculum's utter lack of modern examples, and the real-life statistics of S.T.E.M. graduates, the curriculum is not doing a good job of representing a wide variety of scientists and their achievements.

6) **Take Charge of the Medium:** Select a scientist who, according to what you described in (4), has been excluded from the curriculum. On a poster, outline their name, their achievements, the reasons for their exclusion, and where you believe they should be included in the Physics 40S curriculum. Implement various media literacy codes to enhance the messaging of your poster (ex. colour, typography, background, page layout, etc.), and be sure to consider and include the larger societal impact of the inclusion of this person.

I have selected Émilie de Châtelet as a female scientist who I believe is strongly deserving of a place in the Physics 40S curriculum. I have completed a poster which includes all the requirements listed in part (6) of this project. Please see file A1LiaWright_Poster.png.

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Émilie du Châtelet

Paving the way for women in S.T.E.M. since 1706

1

The science world wasn't ready for *Émilie*...

No university for women! "*Fine, I'll hire the best tutors in Europe!*" No place in the history books for women! "*I'll make my own place!*" Women should stay home and take care of babies, not study physics! "*I'll do it all!*"

2

Émilie proceeded to...

1) Translate Newton's *Principia* from Latin to French - the version still used in France today! - and **corrected** his theory about the relationship between kinetic energy and velocity:

Newton: KE is proportional to velocity

Émilie: KE is proportional to velocity squared!

2) Conceptualize the idea of the **conservation of energy** as it moves from one form to another!

3) Postulate that neither *light* nor *heat* have any *mass* and therefore *no momentum* *(she was RIGHT!)*

4) Hypothesize that different colours of light possess *different energy*, which was the basis of future discoveries of **infrared waves**!

3

***Émilie* became the first woman to be published in Paris Académie des Sciences for her accomplishments...**

Funny that only Newton and other men appears in the Physics 40S curriculum, though...

4

What would happen if we put *Émilie* in the curriculum?

GIRLS would see themselves reflected in their studies and feel like they **belonged in physics**!

All physics students would become naturally accepting of diversity in S.T.E.M.!

The curriculum would promote greater diversity in *S.T.E.M.-based programs* in **post-secondary studies and beyond**!

Source

5

Where could we incorporate *Émilie* in our curriculum?

TOPIC 1.6: WORK & ENERGY (SLO's S4P-I-27 and S4P-I-29)

- *See section 2 to be reminded of why she'd fit in these!*

GLO A4: Appreciate contributions made by women & men from many societies and cultural backgrounds toward increasing our understanding of the world and in bringing about technological innovations.

- *Thank you, Émilie, for your contributions!*