Pedagogical Progressivism and Science, Technology, Engineering, and Math Education: A Shared Historical Landscape in Ontario, 1871-1971

by

Alex Chenyu Bing

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Graduate Department of Curriculum, Teaching, and Learning
Ontario Institute for Studies in Education
University of Toronto

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Alex Chenyu Bing

Department of Curriculum, Teaching, and Learning at the Ontario Institute for Studies in Education, University of Toronto

Abstract

This thesis is part of a larger project to sketch a history of how the science, technology, engineering, and math (STEM) subjects were structured in Ontario public schools. The thesis begins by studying the longstanding forces that have demarcated science from other subjects from the 1870s to the 1960s. It then examines the 1960s as a pivotal decade when the effects of school guidance counsellors, economic imperatives, and the preoccupation with human selection accentuated those longstanding divisive forces in public education. These developments culminated in an institutional entrenchment of disciplinary gulfs within the schooling system, opened the door to a constructed embodiment of subject-specific talents inside the child, and alienated math-related subjects from pedagogically progressive visions of education. The guidance movement and the reforms in mathematics during the 1960s were scrutinized in detail. The role of progressive education in its own marginalization from STEM subjects is also examined.
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Section 1: Introduction

Brief Synopsis

This thesis offers an examination of science education’s complex relationship to the progressive education movements, as well as to broader social changes in the Ontario public school system from the 1870s to the 1970s. The thesis is divided into three parts. The first part touches on a range of factors in Ontario education that contributed to the current demarcation of school subjects, starting from the early 1870s to the late 1950s. The second part focuses on a range of educational and social developments during the 1960s. The third part focuses on the role played by progressive educators in these series of developments, and explores ways in which progressive educators might have unwittingly participated in their own marginalization within science education.

Underlying areas of interest

This paper strives to remain sensitive to three concentric thematic areas. Although they are of equal importance, they can nevertheless be thought of as being concentric in their scope. [1] First, at the subject level, is the rise of science as a mainstream subject within the North American schooling system, and its evolving relationship towards other subjects. [2] Secondly, zooming out to the school level, is the rise of a worldview where education is perceived as a science, often marked by a formalistic view of curriculum and a medicalized view of human learners and even teachers. [3] Thirdly, zooming out to the social level, is the vested interests in science education increasingly held by political, economic, and military forces in North America.
Different existing literatures touch on some combination of these three areas, although, as I will argue, most fall within four distinct perspectives or approaches: technical instrumental, critical sociological, social constructivist, and comprehensive historical.

**Literature review**

What I call the “technical instrumental perspective” on STEM (science, technology, engineering, and math) education focuses on how effectively and efficiently science-related social practices, mainly science teaching, accomplish certain intended tasks, be it liberating the individual child or increasing the quality of the labour market. Such a perspective often naturalize a scientific view of education itself, and might even regard the medicalized curriculum\(^1\) as a crucial tool in making the school at once more sympathetic and efficient. As suggested later on in the paper, reports published by government agencies and policy circles also tend to fall into this category.

As a major example, the *Journal of Research in Science Teaching* has, in recent years, frequently included articles that branch out to psychology, sociology, and cultural studies, in order to address factors that render their students less receptive to what science educators consider scientific knowledge.\(^2\) The journal started out in 1963 as a periodical steeped in

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\(^1\)“Medicalized curriculum” is a term used by George Tomkins. See Tomkins, George S. *A Common Countenance: Stability and Change in the Canadian Curriculum*. Vancouver, BC: Pacific Educational Press, 2008, p162-172. Within the scope of my paper, medicalized curriculum refers to using biology to explain why students succeed or fail.

discourses of content knowledge, intelligence testing and human selection, but has taken a more critical turn in recent years to challenge what Archer, DeWitt, and Willis call a “pipeline model” of science education where, they argue, some children are to be picked out and railroaded on an insular path towards science degrees and science jobs. (In those latter cases, the work being done gravitates toward what I call “critical sociological” and “social constructive” perspectives, which I will talk about shortly after.)

Another example of the “technical instrumental perspective” is the *Journal of STEM Education*, which originated in 1999 and is comparatively more conservative in its thrust. The journal openly and officially aims to “respond to employer needs and expectations.” Instead of attributing student failure and poor retention rates in STEM disciplines to factors such as social inequalities and market failure, some articles in this magazine instead attribute them to being cut off from their families, lacking a source of authority, and showing insufficient resilience in the face of neglect. Other entries are aimed at providing new models and pedagogies that will make STEM education conform better to the labour market by producing graduates that are more in

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line with what employers want.\(^7\) Like other writings from the “technical instrumental
perspective”, these articles are concerned with how effectively and efficiently science-related
social practices, including science teaching, accomplish their goals.

Overall, there are both progressive and conservative attitudes within this perspective. But,
in my framing, their shared trait is an instrumental attitude geared towards increasing the
retention rate of STEM educational streams and careers. They largely avoid criticizing the labour
market towards which their students are funnelled, and they seldom engage the history of their
own science in search of contingencies. Their gaze is firmly focused on their instrumentalist
goals.\(^8\)

Second, there is what I call the “critical sociological perspective”, to STEM education,
which tends to focus on the deleterious effects of scientific, quantitative, or otherwise
programmatic paradigms on educational research and practice, often with a focus on the
contemporary through a sociological lens. The works of D.W. Livingstone, and Bob Davis are
two good examples in this regard.\(^9\) These perspectives in general touch on all of the
aforementioned concentric areas of interest – science as a discrete school subject, scientific
views of education itself, and science education as a key element within the military-industrial
complex – although historical factors are sometimes downplayed and the social construction
process of the status quo is not often recounted in the form of detailed historical narratives.

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\(^7\) See for example, Adams, S. G. “Building Successful Student Teams in the Engineering Classroom.” *Journal of STEM Education*, Vol. 4, no. 3 & 4 (2003): D1-D6. Employers have sometimes deplored a lack teamwork skills in engineering graduates, and the author was restating the problem and offering a paradigm for pedagogical solutions.

\(^8\) It is important to realize that not every journal is monolithic in the kind of views they publish. *Journal of Research in Science Teaching* for example, as mentioned, began as a very instrumentalist journal but has published articles that fall outside of the “technical-instrumental” category in recent years.
In many ways, Davis’s analysis is a notable exception to the ahistorical approach. Davis deplores the erosion of history in newer Canadian curriculum, but suggest that the tools of critical sociology can help combat the mechanistic and cynical trends in current educational systems. Moreover, of particular relevance is his nuanced recognition of the dual nature of science, both as a pragmatic, misery-relieving culture envisioned by C. P. Snow on one hand, and an exploitative-controlling culture envisioned by Martin Heidegger on the other.

Nevertheless, Davis has chosen not to dwell too much on either the long history of mechanical approaches to education, or the origins of human capital theories that contribute to the “skills mania” that he set out to critique.

As another example, Livingstone’s sociological critique of human capital theory gives a brilliant analysis of how education levels in society can increase without a concurrent increase in jobs, and brings attention to ways in which the framing of education downplays knowledge possessed by the working class and the poor. He also talks about “deskilling trends” in the face of unemployment, where the same low challenge responsibilities can afford to demand increasingly inflating certifications, while skilled people are forced into unskilled jobs. Livingstone thus unmasks a rhetorical mechanism by which the level of education in the society can always be downplayed, making it easier to hold insufficient or inappropriate education to blame for mass unemployment. However, what would have given these already powerful

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10 Davis, Skills Mania, 2000. p86.

11 ibid, p169-171.


13 ibid, p139-148
arguments even further depth is a historical perspective. Consider for example, the 1965 annual report from the Economic Council of Canada, which suggested that, beyond the need to increase the education level of the people in general, increasing the education level of senior management is a distinct priority that could bring the Canadian economy a step closer to resembling the American economy.\footnote{Economic Council of Canada. Second Annual Review: Towards Sustained and Balanced Economic Growth. 1965., p62} This can be plausibly read to suggest that in the Canadian context, a system geared towards training business leaders could have been one of the deliberate visions of education, rather than just a structural effect. Moreover, in the history of the Canadian engineering profession in as early as the 1930s, deskilling was already a common practice that really blurred the line between white and blue collars. When economic conditions tightened, engineers were often relegated to the assembly line.\footnote{Saunders, W. A. B. “The Changing Pattern of Engineering Education.” Canadian Journal of Aeronautics Engineering. Vol. 5, no. 2 (1959): 171.}

Overall, these examples are invoked just to demonstrate that the “critical sociological perspective” can engage even more powerfully in its dialogue with the “technical instrumental perspective”, if only a historical dimension was more routinely invoked.

Thirdly there is what I like to call a “social constructivist perspective”. This often involves an historical examination of how scientific practices in general, and science education in particular, impacted the social construction of gender, class, and childhood in the 19th and the 20th centuries. Good examples in literature include the works of S. G. Kohlstedt and that of J. A. Stephen.\footnote{Kohlstedt, Sally Gregory. Teaching Children Science: Hands-on Nature Study in North America, 1890-1930. Chicago: University of Chicago Press, 2010.; Stephen, Jennifer Anne. Pick One Intelligent Girl: Employability, Domesticity and the Gendering of Canada's Welfare State, 1939-1947. University of Toronto Press, 2007.} This perspective dwells mainly on the second and third aforementioned areas of
interest – scientific view of education itself, and science education as a key element within the military-industrial complex – but the work of Kohlstedt in particular has also paid a great deal of attention to the first area as well; that is, to science as a discrete school subject.

In her book *Teaching Children Science*, Kohlstedt traces the history of early science education in an American context. She documents ways in which North American educators during the late 19th century often consulted European systems for ideas. One product of such influence was a practice called “Nature Study”, which became popular during the 1880s in the United States. The catchphrase served as an ambiguous symbol for a wide range of ideas about education, including outdoors education, science education, educational psychology, agriculture, vocational education, and hygiene, but it also signified a movement that “introduced science into public schools of North America”.

During the 1890s in the American Midwest, Nature Study had considerable traction in the pedagogical circles. Its chief proponent was Francis W. Parker, an experienced teacher and educator who first worked in a normal school. Then he presided over an ambitious experimental private school that eventually amalgamated into the University of Chicago in 1902. Parker developed a close cohort of colleagues throughout his career, including Henry Straight who was a champion of tactile education at a normal school, and Wilbur Jackman who was an advocate for science education. The amalgamation in 1902 also made Parker a working colleague of John Dewey, who was then a professor at Chicago’s Department of Education and in charge of a “Laboratory School” focused on child-centred education. In a way, manual education, science education, and child-centred education became an integrated tripartite under a broadly

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“progressive” intellectual network in the early 1900s. This configuration is also largely in keeping with the Ontario narrative, where manual education, industrial education, and child-centred education signified various progressive thrusts levelled against an older system of bare literacy, book learning, and memorization.

Interestingly, in the beginning when there was much skepticism from trustees and senior teachers, anti-nature remarks were often intermixed with sexist ones. This strongly disrupts the common stereotype that women did not historically have a large role in science. Kohlstedt noted that in the beginning days of science education in the schools, most teachers of “nature study” were women. Conflicts of interest persisted between female teachers who worked to make science pedagogically accessible, and male academics who wanted to make science formalistic and disciplinary. Many influential educators were known to have complained about the “feminization” of nature study and its apparent lack of scientific rigour in the same breath. Notably in particular, Edward Thorndike believed that only a talented few was suited to learn science, and that women could teach it at a lower level but not at a higher one. Other contradictions also existed. One very important tension existed between the proponents of child-

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18 ibid, p52-57


20 Kohlstedt, Teaching Children Science, 2010. p16

21 ibid, p8

22 ibid, p171. Other critics, such as G. Stanley Hall, Charles Bessey, and C.B. Wilson, were all known to speak as if the feminized teaching force and the lack of formalism in science were not only problems, but connected ones. Thorndike was given a special mention because his student, Peter Sandiford, became very influential in Ontario during the 1920s. Sandiford would become the vanguard of the hygiene movement in Ontario during that time.

23 ibid, p171 and 180. Thorndike was insistent that any kind of science education that was not rigorous should not even be taught, and that it was better to not teach it at all than to teach it accessibly. In a way this forecasted the institutionalized search for giftedness many decades later, which can be seen as a way to circumvent the need to teach a difficult subject in an accessible way by assembling a student audience that required no accessibility.
centred pedagogy and the proponents of citizenship education. While they were both participants in the broad progressive movement, they had very different agendas. One of the biggest topics of civic reform at the time was hygiene, and this was true in both Canada and the US. In the US context, hygiene was incorporated into nature study for a time, but parted again in the 1920s once hygiene became a major topic in the school on its own right.24

Kohlstedt’s work is a rare example that sets up two valuable frameworks. First, it empirically situates science education within the historical landscape of progressive education, a background understanding within which it becomes possible to talk about relationships between science education with childhood psychology as well as citizenship education without sounding as if we are trying to weld unrelated concepts together. Secondly, by exposing gender compositions of early science teachers on the one hand, and expert psychological theorists on the other, in addition to giving quoted opinions from influential figures from both sides, it creates a discursive background that relates the contradictions between formalism and access within science education to issues of gender construction in that same field.25 Although the study is mostly confined to an American context and stops short before the end of WWII, the frameworks that were drawn are still useful in a Canadian context and over a slightly longer period of time.

Stephen’s historical study of Canada’s gendered welfare system shows that science-inspired human selection procedures have enjoyed extensive adoption as early as WWII.26 The military used these procedures to select who they thought were good soldiers that could not only

24 ibid p137-142
25 ibid; p137-142 draws a connection between science education and citizenship education, while p171-180 draws a connection between gender and the formalism-access dichotomy.
fight well but more importantly readjust easily back into civilian life as soon as they returned home. The system of procedures used to screen recruits for initial selection could also be applied to the soldiers throughout their service to provide a kind of “evidence” as to whether trauma or psychological damage have taken place. The standards and metrics were influenced by the American development of aptitude testing during the interwar period, and hence inherited some of its racialized ideologies. Moreover the testing system produced “evidence” to justify the immediate reinjection of male veterans into a labour market that has been substantially feminized by encouraging women essentially to lay themselves off.27

These findings are relevant to the educational context, as they suggest several things. First, ability testing already saw a high level implementation during WWII in terms of both complexity and popularity. Second, the influence of the military-industrial complex on the school system would have reinforcing effects for the popularity of human selection procedures within the schools. Thirdly, the “objective” nature of the system notwithstanding, the system can be steered to produce the type of evidence needed by external interests. Fourthly, if there really is a will to give jobs to a particular population, there could still be ways to do so even without first sending them to school.

Overall, the social constructivist perspective can potentially address a broad range of issues, focusing in each instance on how certain patterns of social thought or practice first took off. In the case of Kohlstedt, the focus was on how newly introduced science education inherited old gender hierarchies, even as the subdued side contributed greatly to the subject’s advancement. In the case of Stephen, a similar contingency was unmasked about the relation of women to the rapidly developing military-industrial complex.

27. ibid, p141-143
Fourthly and last there is what I call the “comprehensive historical perspective,” exemplified best by comprehensive historical narratives. Within the Ontario context this is exemplified by the works of W. G. Fleming, R. M. Stamp, and in a broader pan-Canadian context by G. S. Tomkins, all of which have sketched a very comprehensive history of the province’s schooling system. Much like the constructivist perspective, the comprehensive perspective has again done a very detailed job of describing my second and third thematic areas – a scientific view of education itself, and science education as a key element within the military-industrial complex.

The works of Tomkins and Fleming in particular, being large and comprehensive in nature, devoted some sections to subject-specific issues. But for the most part in this kind of literature, detailed descriptions of schooling systems in Canada have focused on social-historical themes, such as dominance of religion, medicalization of the curriculum, structural inequality, schooling and urbanization, and so on. They deal with, in short, the social-historical externalities of how schools are run in addition to how these externalities shaped pedagogy. What these brilliant accounts can use is a supplementary account that attempts to grapple with how the need to interrogate those important externalities have been marginalized by a list of subjects that do not compute any of these issues. My claim is that a history of “which ideologies are taught in schools and how” can be greatly complemented by a history of “which subjects are taught in schools and how”. In addition to histories of pedagogy and histories of their social externalities, histories of particular subjects are also very important in their own right in understanding the inequalities, contradictions, and critical issues inside the schooling system.

Literature Gaps
There is a gap of major importance, in that there is a need to bring science education in public schools explicitly into conversation with the social, historical, and cultural contexts of scientific development. To be sure, many contemporary educators have called for an increase in “science and society” courses in the curriculum, and histories of science education have also appeared on occasion. But the demand of these issues are typically dismissed as being extraneous and externalist, especially by conservative proponents who insist that there is a pure science to be had that can be wholly separated from its own social effects. Thus one of the aims of my paper is to offer a landscape where the four aforementioned perspectives (certainly not an exhaustive list) can be brought together, and be seen as part of something common.

Before talking about how I lay out plans for my landscape, I want to mention that landscapes of a somewhat related nature have been set up in the past. Suzanne Zeller’s study of Victorian science in Canada made a number of connections between the perception of educators, the dilemmas of policy makers, the interests of industrialists, their common neglect of the working class, and the elite culture’s reluctant parting with tropes that pitted the mind against the body. Nevertheless, the study’s content and framework is tangential to the project that I wish to undertake. Zeller’s work describes how science, manual and physical aspects of learning, and a

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prejudicial attitude towards the poor intertwined fairly early in the Victorian era within universities. But her framework was not geared toward addressing the public school. Due to the denominational nature of universities during the whole of the 19th century, the fairly late emergence of a public school system, the high turnover rates in schools for even much of the 20th century, and the relatively governmental control of schooling for many decades after its inception, university culture did not make structural incursions into the public sphere until after the world wars.

The landscape that I seek to construct would be one that places the public schooling system much closer to the centre of inquiry. Although our foci are quite different, Zeller’s work does offer insights on how ideologies were shaped amongst university-based content experts. To anticipate my own findings later on, those familiar with her work will be less surprised at the mentalities of content experts in the 1950s and 1960s when they formally entered into the curricular arena.

In order for my landscape to be inviting to the various perspectives however, it would have to complement each perspective with something that the perspective does not often see. First, the technical instrumental perspective, even when it does deal with social and cultural externalities, often lacks a history of science component. Second, the critical sociological perspective, besides being sometimes ahistorical and ideologically charged, does not often place actual curricular content at the centre of scrutiny. Third, the social constructivist perspective, while having the capacity to place subject content and organization under historical scrutiny, are often busy scrutinizing other important social patterns and only engage educational concerns tangentially. The exception is when a particular subject is directly scrutinized, as was the case with the Kohlstedt study on the sciences. But in my own foraging of the existing literature,
similar dedicated studies in a Canadian setting are few and far between. Lastly, the comprehensive historical perspective, while complementing the single-issue framework of the social constructivist perspective with considerably more breadth, focuses more on a history of practices rather than a history of thought.\textsuperscript{32}

For the above reasons, I would like to add to the existing conversation in literature by providing a history of content, dealing mainly in the Ontario context, with a special focus on the role of STEM content. Right now I think there is a need especially in the Ontario context to trace a history of content, especially the content of STEM subjects, and place it in a three-way conversation with the histories of pedagogy, as well as the social-historical externalities surrounding education. This way, I can complement the first perspective with a history of science, complement the second with a history of educational content, apply the third perspective in a context of Ontario science education, and complement the fourth perspective with a history of thought that could have accompanied the practices they document. The motive here is to implicitly bring these perspectives into conversation by bringing them inside the same social-historical landscape.

\textbf{Research process and methods}

\textsuperscript{32} There may be exceptions to this in shorter articles that appear as parts of anthologies. See for example Van Brummelen, Harro. “Shifting Perspectives: Early British Columbia Textbooks from 1872-1925,” in \textit{Schools in the West: Essays in Canadian Educational History}, edited by N. M. Sheehan and J. D. Wilson. Calgary, AB: Detselig Enterprises, 1986. But as the scope of a historical study grows large, and as the range of its various subtopics grow more and more expansive, it becomes increasingly impossible to illustrate clear and distinct social change and the driving forces behind them. What we tend to get is a panoramic view that shows a history of practices rather than a history of thought.
The research made use of a diverse mixture of primary and secondary books and documents, spanning the areas of educational policy, educational history, official statistics, technical journals in science, technology, engineering, and math, as well as economic policy documents and other economic literature. Some of those sources are actual works of history, but they were written at such a long time ago that they were instrumental in illustrating prevalent thoughts during the times of those authors, effectively acting as primary sources in themselves. These historically contingent works of history therefore served as both primary and secondary sources. Overall, the kinds of sources used were as follows. Firstly, a range of primary sources generated by government bodies, including the Annual Reports of the Minister of Education in Ontario, quantitative information from the Dominion Bureau of Statistics, conference documents and annual reviews from the Economic Council of Canada, as well as pre-1970 professional Canadian journals in the areas of science, technology, engineering, and mathematics. Secondly, other primary sources, which are historically contingent works of history very much rooted in the historical contexts of their own times, and come from the eras that are no later than the 1960s. They served as both a source of facts, evidence about what was going on in schools and curriculum development, as well as an indicator of prevalent thoughts in the times of those authors. Thirdly, historical accounts published after the 1970s, which are not considered primary sources, as well as other secondary literature related to areas such as economics or sociology also fall into this category. These historians, educators, sociologists, and economists provide a range of overlapping contexts that has helped me situate my work in larger discussions about science and education.

Additional questions regarding the nature of the project
Before proceeding further, I want to frame the project a little more precisely. [1] To start, I want to clarify what I mean by “progressive education” within the scope of this paper. [2] Then I want to clarify my intentions a little more in light of the meanings I have drawn. [3] Finally I want to position this paper within the broader social-historical tradition.

Firstly, as noted by Tomkins, “progressive education” in its narrow sense was a phrase of US origin that appeared on the Canadian scene during the 1920s firstly and mostly in western Canada, and often loosely invoked with “both liberal and conservative dimensions”. He disambiguates progressives into two camps, that of the “administrative progressive” and that of the “pedagogical progressive”, with a will towards change and a questioning attitude towards established practices as their only common thread. Tomkins remarks further that the former type was “closely allied” with educational scientists, and its notable Canadian representatives include George Weir in British Columbia and Peter Sandiford in Ontario; while the latter type was notably represented by Hubert Newland in Alberta. The former type stressed the usefulness of a structured and regulated mass schooling system towards social control, and was often prone to framing children and even teachers as objects of a science-like system of inquiry. The latter type advanced a child-centred pedagogy that placed the importance of the child above the content they are slated to learn. J. D. Wilson drew a similar dichotomy, with more overtly American icons: the administrative progressives were best represented by Thorndike


34 ibid

35 That this kind of modelling has been done on children is well-established. But the medicalized curriculum has at times placed teachers under its reticle as well. See for example Blankenship, J. W., *Journal of Research in Science Teaching*, Vol. 3 (1965): 54-60.

(incidentally, Sandiford was Thorndike’s student), and the pedagogical progressives were best represented by Dewey.\textsuperscript{37}

In the scope of my paper, the meaning of “progressive” is broader. It includes various educational initiatives in Ontario between 1880 and 1920 that challenged traditional views and practices of schooling, especially the advocacy for manual education in the 1880s and the advocacy for industrial education in the 1910s. There are of course risks to stretching the meaning of the term, but my philosophical position is that an idea or a practice can still exist prior to it being named. Even when “progressive education” is invoked in the standard sense as described by Tomkins, we have to ask, progressive instead of what? That is to say, what precisely were the traditions that newer forms of schooling tried to progress out of?

To defend my position on this choice of meaning, I will have to anticipate a few things that I really should be saying later on in the next chapter. Rhetorical dichotomies about “Old Education” and “New Education” were invoked in Ontario at least as early as the 1880s, and such terms also were used liberally in the works of Francis Parker, one of the forerunners of US progressive education.\textsuperscript{38} When this dichotomy was invoked by J. E. Wetherell in Ontario, he expressed concerns against old practices such as mentalist conceptions of learning, and practices that taught knowledge by rote. Against this, he showed preference for new educational practices that carried a holistic conception of learning coupled with teaching practices that encouraged the child to learn through self-interest.\textsuperscript{39} I would argue here then, that in terms of social thought, a

\textsuperscript{37} Wilson, J. Donald. \textit{An imperfect past: Education and society in Canadian history}. Centre for the Study of Curriculum and Instruction, University of British Columbia, 1984., p18

\textsuperscript{38} ibid, p59

\textsuperscript{39} ibid. Note further that denouncement of rote learning was not a rare thing back in the 1880s. Ryerson himself advanced a child-centred view of schooling, regardless of what his motives were. See ibid, p51.
perceived binary between the rote-mentalistic doctrine and the pedagogical-holistic doctrine was already emerging in the social imaginary in the Ontario of the 1880s. Even before the 1920s, some thinkers, and not just in Ontario, have begun to shift focus from the content to the child, and from the mind to the body.\(^{40}\) That advocacy for “manual education” also emerged in Ontario in 1884 cannot be wholly accidental. Indeed its proponent, James L. Hughes, later became acquainted with Francis Parker,\(^{41}\) who also knew John Dewey. Thus we can see that an intellectual network was already beginning to form between the various change-advocating educators before the turn of the century, and that educational thought in Ontario did not really evolve in isolation. Although it can be argued, as some historians, that there is no such thing as a unified vision of progressive education,\(^{42}\) it nevertheless is always a force for change in whatever context it arises. If there is a pattern to the practices and thoughts being questioned and changed across diverse contexts, then that context transcending pattern can participate in defining what progressive education entails. Recognition of the embodied aspect of the child, as well as a suspicious attitude towards rote learning, should be fairly staple items on the progressive list of preferences. When these items arise in the same decade, advanced by educators who knew each other, it is not unreasonable to argue that the changes they pushed for was part of a shared fabric in some broad way.

Secondly, going off on a slightly different tangent, if administrative progressives and educational scientists were “closely allied”, then to say that the administrative progressives

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\(^{41}\) ibid, p58
contributed to the place of STEM subjects in the school would not come as much of a surprise. But my intention goes beyond this. I am also interested in finding science education’s links with the other branch, that of the pedagogical progressives. These are educators for whom the primary concern, more so than any subject or set of content, is the actual child. Within my paper, unless otherwise stated, whenever I use the shorthand “progressive” I refer in particular to pedagogical progressives who overtly advance a child-centred curriculum.

Thirdly, I want say some more things that are geared towards making my project and my position easier for readers to pin down. Here I want to invoke a categorical classification put forth by J.D. Wilson and later repeated by Kaz Mazurek, who have divided works of educational history into four camps. The first camp they call “Whig”, meaning that they examine the schooling system in a vacuum without recourse to its embedded contexts, often lauding its status quo or progress uncritically, and see it only in terms of its relations to the inevitability of the present. The second camp they call “Social Historians”, which seeks to paint the broad social-historical landscape within which schooling institutions have evolved, often resulting in large, comprehensive narratives. The third camp include two variants of “Revisionists”, the radical and the moderate. Radical revisionists have a top-down conception of the schooling system, framing it as a site where dominant classes reproduce power relations in their favour. Moderate revisionist have a more bottom-up conception of the schooling system, and like to focus on how local and contextual factors obstruct its intended objectives, whether for worse or better. Both variants of the third camp tend to have a narrower focus than the comprehensive


social historians. Lastly the fourth camp consist of “Ethnographic Historians” who focus on the lived experience of the people who are stuck living in a given system, and their attempts to cope with its crushing forces. These four camps may sound similar to the four perspectives that I have listed previously, but there are important caveats. The technical instrumental perspective, often times, is not even Whig. Its historical dimension is virtually absent, with few exceptions. The critical sociological perspective, while often invoking a conflict theory model in a top-down structural fashion, may not necessarily invoke much history at all. Moreover, none of the perspectives I have identified corresponds very well to ethnographic history. Fortunately, Wilson and Mazurek’s “social historians” translate very well into my “comprehensive historical” perspective, and their “revisionists” translate fairly well into my “social constructivist” perspective.

I would situate this paper somewhere in between those last two camps. On the one hand, I do want to try and paint a fairly comprehensive social-historical landscape, with analyses that touch on the subject level, the school level, as well as the social level. In this sense, I am similar to the social historians. On the other hand, my aims are fairly particular, namely to deconstruct the science-society divide by historicizing its underlying social thought. In this sense, I am similar to a moderate revisionist with radical leanings. I believe that while science education is a key participant in social control, through “creating a disciplined labour force and maintaining a politically passive working class”, liberal transmission of scientific knowledge is still of great importance and deserves our sympathy especially in light of its historical circumstances.

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It might still be rightly asked, however, why I did not plan to include the ethnographic perspective into the landscape I am trying to build. For after all, as Wilson argued thirty years ago, though not altogether without grudge, the study of “private spaces” where singular people covertly carry out resistive discourse has become the newest way of conducting social-historical research. Here I would argue that indirectly, my landscape also offers something for their perspective. Before any account of “lived experience” can be taken seriously amongst professional scientists, science educators, and students of science, it would first have to confront a skeptical structure that will dismiss it as being irrelevant. To overcome this barrier, we would first have to trace a history of how and why so many things came to be considered irrelevant to science and science education. Thus the social-historical landscape I am trying to construct is the first step on the long road to making lived experience matter.

Furthermore, even as such perspectives stress upon how people adapt to their environments, they still have to adapt as people who possess perception, and are hence people who are constantly interpreting the world. These people, however singular and embodied, have to use interpretive frameworks that are socially shared. These interpretive frameworks can still be held up to social-historical analysis. This is another way in which the historicizing of hermeneutical systems can be of interest and use to the proponents of phenomenology.

To anticipate something that will show up in the body of the thesis, what people in the educational system interpreted as science, and what these people interpreted science to entail, changed over time. Such people included policy makers and academics who wielded considerable influence over what was to be taught in schools. Moreover, how can the “lived

46 Wilson, An Imperfect Past, 1984, p13
experience” of teachers, students, or even industry sponsors in science education be understood, unless the meaning of “science” is understood on their terms?47

47 On a more practical note, research involving student subjects is extremely difficult to receive ethical approval for, and involves community engagement on a scale that is not possible within the confines of a Master’s Thesis. Such constraints preclude the possibility of phenomenological studies that elicit autobiographies from students who are coping with systems or peer groups that might possess resources to censure those who speak up.
Section 2: Key historical themes leading up to the late 1950s

The longstanding tension between science and classics

In an annual report to the provincial education department in 1871, J. G. D. MacKenzie briefly discussed the desirability of inserting "physical sciences" into the curriculum.\(^{48}\) The eight-page report devoted about half a page to the subject, and within that space MacKenzie made three intentional points and gave away one inadvertent undertone. [1] Contrary to the doubts of some, learners who study science well do not automatically perform worse in the classics. [2] The insertion of science provided an alternative set of accepted activities, without which a greater number of "boys" would become delinquent. [3] He was diffident on whether adding science on top of the classics will overload the learners and the teachers. On one hand, he cautions against opening the school to science too much and too fast, lest overloading does occur in both the content and the management thereof. On the other hand, he cites a number of his credible contemporaries who gave testimony to the contrary. [4] Mathematics was not bundled with science in the language of the system at the time. Mathematics was treated as a literacy, along with reading and writing.

According to W. G. Fleming, two elements of subject-based streaming appear to have quite a long history, dating back to at least the Ryerson era.\(^{49}\) First is a fragmented conception of


the different subjects; second is a tendency at times to overload the curriculum with too many such subjects. This propensity to overload was only kept in check by not requiring students to take every subject that was available. To this one might add a third element, namely an atmosphere of antagonism between the old classics and the emerging sciences. In Britain, as early as 1859, the Spencer-Arnold debate bluntly raised the question “what knowledge is of most worth?” Spencer offered science as the answer, whereas Arnold defended the primacy of the classics.\footnote{Tomkins, \textit{A Common Countenance}, 2008, p35-36} However as Tomkins notes, during the early Confederation days Canada did not have a regimented educational system, let alone any significant attendance in the higher grades. Any resonances with the debate remained abstract in the Canadian context, without any educational engine to practically side with one or the other. Ironically the Spencerian, pro-science position was treated as a kind of literature and thus had a modicum of traction among Canadian academics.\footnote{ibid, p35-36} In any case, even though the science-humanities divide did not immediately express itself in any realistic form in the Canadian context, the idea of this divide took root at quite an early date. Edwin Guillet, in documenting the history of the Ontario Educational Association (OEA), shows how a perceived opposition between older cultural disciplines and newer scientific disciplines was already well-established in the province's higher education sector as early as 1873.\footnote{Guillet, Edwin Clarence. \textit{In the cause of education: centennial history of the Ontario Educational Association, 1861-1960}. University of Toronto Press, 1960.} In the OEA meeting of that year, Principal J. H. Hunter of St. Catharines Collegiate accused the University of Toronto for having a curriculum “overloaded with classics at the expense of science”.\footnote{ibid, p65} When arguments surrounding industrial education began to increase
around the 1910s, “science” was at times discursively enlisted by pro-industrial reformers.\textsuperscript{54} Although in the later years this habit gradually discontinued, residual prejudices persisted in that even abstract science did not occupy a clear niche in the literacy-versus-relevance discursive dichotomy.

**Manual training and Industrial education**

The long-standing tension between the classics and the sciences was further complicated by a second tension between a curriculum for the docile versus a curriculum for the unruly. Industrial education was a key ingredient in the formation of subject-based streaming, though the concept of industrial education has had many shifting interpretations throughout history. The term was being invoked in the Ontario Educational Association as early as 1870; however this term was quite imprecise when it first emerged:

> The committee suggested an amendment reading that refractory, vicious, or criminal children should be removed to an Industrial School, feeling that, in cities and towns particularly, the new principle of compulsory attendance might overload the schools with 'street Arabs' [sic] to the detriment of children from more fortunate environments.\textsuperscript{55}

At that time, “industrial” often served as a code word for students deemed less desirable by the more privileged. Deviations from this meaning began to emerge in 1884, James L. Hughes presented a paper at a meeting of the Ontario Teacher's Association. The topic was “industrial

\textsuperscript{54} Stamp, Robert M. *The Schools of Ontario, 1876-1976*. Toronto, ON: University of Toronto Press, 1982. p80

\textsuperscript{55} Guillet, *In the cause of education*, 1960, p55
education”, and that was the first time where the word “industrial” was used to signify manual labour. Previously, "industrial" only had one of two meanings. Either it referred specifically to the training of mechanics instead of manual labour per se, or, it referred to charitable initiatives whose aim was to take care of disadvantaged children.\textsuperscript{56} Meanwhile, the phrase “manual training” also made its way into Ontario in 1889; Tomkins note how this phrase too was lacking in precision at the onset, and referred to a wide range of non-academic schooling with a multitude of conflicting purposes.\textsuperscript{57} Two of these purposes included keeping non-academic children in school by legitimizing something they might do well, and secondly to provide graduates that were fit for an industrializing job market. In the 1900s, when it became apparent that “manual training” did not connect the school to the industrial vocations as well as some of its supporters have hoped, “industrial education” under the advocacy of Seath began to explicitly distance itself from “manual training.”\textsuperscript{58}

Thus industrial education in Ontario became redefined in the early 1900s, under the superintendency of John Seath and the conservative Premier, James Whitney. Previously in the Ryerson era, Seath was a textbook writer and a fairly prominent educational critic, who was known for his opposition to difficult standardized tests, and a funding system that only rewarded schools that did well on them.\textsuperscript{59} He made his first administrative debut in 1885, when he was appointed as an inspector of high schools. In his report to G.W. Ross, the Premier at the time,


\textsuperscript{57} Tomkins, \textit{A Common Countenance}, 2008, p109

\textsuperscript{58} ibid

\textsuperscript{59} Squair, \textit{John Seath and the School System of Ontario}, 1920. p44; p55
Seath critiqued the high school system for a number of inadequacies.\footnote{Government of Ontario. \textit{Report of the Minister of Education}, 1885. Appendices Section H, p152-172.} A reading of his report shows several interesting things.

[1] First, compared to many of his colleagues, who contributed no more than a page or two in their sections, Seath’s section was over fifteen pages long. In that report, Seath himself said near the beginning that he has focused mostly in speaking about the areas that needed improvement. This is interesting because, if he has only talked about the negative aspects of the system, but yet produced a report that was several times longer than that of his average colleague, this can only mean one of two things. Either he saw many flaws in the system, or he saw several flaws for which he had a detailed plan on how to fix. A closer reading reveals that it is a combination of the two. His critique of school facilities goes beyond the level of counting chairs in the room, the number of desks that were missing, the number of rooms missing blackboards, or the amount of funds raised by the trustees.\footnote{This can apply, for example, to other reports from his fellow inspectors in the same year. Seath was one of two high school inspectors in the province that year. J. D. Hodgson, the other high school inspector, talked mostly about reading and grammar and wrote less than four pages in total. See ibid, p149-152.} Rather, he discussed in detail about the lighting in the room affecting student concentration, poor ventilation mechanisms that forced teachers to open windows in winter and making the students sick, cheap gyms built in dank basements that did not give good air to students who exercised, and so on. In short, his highly technical vision of educational provision went beyond the simple logic of accounting, and his liberal inclinations towards education were tinted with a technocratic outlook that was unusual among his colleagues. The technocratic turn in Ontario education was thus already forecasted in Seath’s first report, long before he himself became the provincial superintendent in 1906.
[2] Secondly, Seath deplored the overemphasis on mathematics, and yet at the same time criticized the neglect of the sciences. To be sure, he was not using the word “science” in any casual, imprecise way; he had specifically in mind physics, chemistry, and “botany” (biology) and said so explicitly in his report.\textsuperscript{62} This is very interesting because it contrasts with our present-day understanding of how mathematics are inevitably embedded in the sciences. Indeed, Seath in his day was quite critical of teaching too much math in lieu of the sciences. This fact makes an interesting juxtaposition with present-day understanding, which so frequently lumps math and science together in the attempt to construct an integrated subject stream. In reality mathematics in the past has been for most part considered a literacy, and not an abstract expression of the sciences. Earlier in the 1870 report a similar rift between math and science came to the fore.\textsuperscript{63} Seeing as how Seath was far from alone in making these kinds of seemingly divisive remarks between science and math, we can be quite certain that his view was not made out of thin air, but rather reflected a perspective that was widely held back in his day. It seems that, at the turn of the 20th century, the combination of science, technology, engineering, and math has not yet become a clear and distinct cause behind which an educator could rally.

[3] Thirdly, Seath’s robust arguments in pushing for an increased emphasis on the sciences is worth noting. One of his main critiques in this regard was the lack of school supplies that could be used by students to conduct labs and experiments. Here we see an emphasis on manual skills, as opposed to literacy skills for which math was actually considered a part. At the same time we can see a corollary: a good science education is dependent on good supplies, which in turn depends on good funding.

\textsuperscript{62} ibid, p161-164

Fourthly, he made a special point about the flaws in the testing system, where more studious learners do worse on exams due to anxiety and exhaustion. Here we see a concern emerge regarding learner health, one that begins to associate the success of the curriculum to the body of the learner. Indeed, by connecting the efficacy of education to the health of the learner, Seath forecasted the onset of a medicalized curriculum long before Sandiford came to prominence in the 1920s.

In our present day, those who oppose vocationalism might face the question, “if not jobs, then what? Isn’t that the most basic thing to teach towards?” But if we look at Seath’s career and what some historians and critics say of him, we actually see that the vocational orientation of his policies was developed in competition to the older orientation towards the liberal arts. John Squair, a conservative historian who knew Seath personally wrote that Seath was one of the first decision-makers in the Canadian context who pushed for an educational system that [1] presented curricular content that was directly aimed at preparing students towards specific jobs; [2] one that therefore contained so many subjects that the volume of traditional subjects such as reading and writing (whether in English or Latin) had to be diminished to make time and room; [3] bolstered schools and programs that pertained to natural sciences, but especially applied sciences that were specifically relevant to various professions; and [4] one that, inadvertently or not, relegated to the background the emphasis on a basic level of general liberal arts for every student. This background understanding makes it possible to understand how if industrial concerns were to fuse into the sciences, the traditionalist and literary skeptics of manual and practical skills would redirect their scepticism accordingly.

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64 Squair, *John Seath and the School System of Ontario*, 1920, p119-120
It is important to realize that there was both a conservative side and a progressive side to Seath’s vocational doctrines. James Whitney, the Premier who put Seath in charge of Ontario’s schools in 1907, was a conservative politician who expressed the belief that vocationalist education will be highly useful in developing the economy, keeping the nation competitive worldwide, and encouraging the reprobates to stay content by normalizing the inaccessibility of an academic education. In hindsight, the history of industrial education remain embedded in a larger narrative that has much to do with the system’s desire to manage unruly children. In the event that industrial concerns fuse into the sciences, the stigmas that literary forces hold against industrial interests can reroute towards scientific interests. The drama surrounding C. P. Snow’s 1959 Rede lecture at Cambridge about the division between science and humanities is an offshore example of when this complex tension came to a head.

As Canada modernized during the 1920s and continued to industrialize in the 1930s despite the depression, the system gradually took on a clearer understanding of what an industrialized society was like. In the 1936 Ministry Report, F.S. Rutherford, the director of vocational education, states in his account that vocational education has been going strong, barring some funding cuts due to the depression. In a section titled “Apprenticeship Education”, Rutherford reports on the intertwining of vocational education and industrial interests. The Apprenticeship Act of 1928 was meant to synchronize bureaucratic, educational, and commercial interests. According to him, this consensus was possible because everyone in the modern society generally agreed that vocational training in a school system was better than

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65 Stamp, *The Schools of Ontario*, 1982, p74

journeyman training in a guild system. In recognition of this, commercial interests have relinquished the control of training over to the school system.\footnote{ibid, p24} This illustrates a major trend in the modernizing society. Apprenticeship was deemed unsustainable because an increasingly industrialized market required younger workers to know more than the older ones. In an apprenticeship model where a static body of skills is preserved and handed down, the accumulation of knowledge could not be accommodated. More generally, it illustrates that the economic structure and the labour training undergirding it was undergoing change. The system’s view of industrial education was becoming more nuanced, although the stigma attached to it by the general public did not go away. In fact, even after 1962, when the Robarts plan was implemented with the accompanying rhetoric that all streams were equal, the streams that were not academic continued to receive stigma from both the student population as well as the admission departments of universities.\footnote{Stamp, The Schools of Ontario, 1981, p206}

\textbf{Literacy as a form of backlash to inclusion, accommodation, and progressivism}

The 1870s ushered in the mandate that schooling was required of all children, even the ones considered “refractory” by the very policy makers that strove to push the system forward.\footnote{Again, see Guillet, In the cause of education, 1960, p55} Since then, the drive to realize this mandate has been an ongoing process. As the industrial and vocation stream normalized, and sloughed off a modicum of stigma that conflated manual schooling with unruly behaviour, it opened the way for an increasing range of “auxiliary”

programs that slowly intertwined with more mainstream schooling. This was enabled in no small part by the growing hygiene movement in the schools, which medicalized the curriculum and created methods that could be used to discipline certain students that could not otherwise be brought into the mainstream system. Of course, in reality, these initiatives of accommodation were just another form of control, and a more systematic one at that. Some historians have indeed documented the discipline and control aspect of the schooling system to a much greater detail\textsuperscript{71}, often directly implicating child-centred practices and demonstrating that acknowledging the existence of the child is actually the first step on the road to controlling the child. But there was a progressive facet to it all, one that was enough to give off the illusion that too much attention has already been paid to the disadvantaged.

Additionally, the school system continued to expand in general, which brought in more and more enrolment in the areas that originally proved prohibitive to traverse. This was yet another development that brought more ordinary students into the system. Coupled with the potential poverty of new students, and the offering of a slightly adjusted curriculum for rural schools that often included agricultural subjects under vocational, industrial, and technical headings, this could have added the impression that the ethos of the previous century was to bring education to everyone.

Backlashes against this whole progressive package often occurred, and they were often accompanied by a call for a return to basic literacy as the focus of the school. This could be seen on the biography of Seath published two years after his death, where his conservative biographer

employed a line of argument that, ironically from a present point of view, portrayed Seath as a hardline progressive who overloaded the curriculum by adding in manual subjects, and thereby crowding out literacy.\(^72\) The perceived progressivism of the 1937 curriculum ushered in by a liberal government caused another era of conservative backlashes in the 1940s and 1950s, predictably reanimating the same agendas of stringent literacy, content-centred curriculum, and heavy-handed exams. The Hope Report in the 1950s contained passages that foreshadow the changes that happened in the 1960s; they deemed that an education based on the experience of the child must yield with age to a more content-based agenda, and that beyond a certain level “the teacher and the pupil have little time for thinking of life situations… and must address themselves for most of the day to the study subject matter organized in separate categories.”\(^73\)

**Systems of testing, positivism, and medicalization**

We can break down the regime of tools enabling subject-based streaming practices into three elements. The relatively primordial element is testing and examination. This has existed in our context long before even the Ryerson era, and once public education became simultaneously free and compulsory in the 1870s, a heavy regimen of exams was ushered in immediately. Interestingly during Ryerson’s reign as the Superintendent, Seath was a staunch opponent of heavy examinations. At a time when Seath was still a principal and a textbook writer, his denouncement of exams was enough to get him passed over for promotion several times, despite

\(^72\) See Squair, *John Seath and the School System of Ontario*, 1920, p119-120. Ironically this sounds similar to what some radical cultural critics say about quantitative knowledge presently. Undergirding such radical positions is the assumption that there are inherent paradigms underneath certain subjects or lumps of subjects, and that these paradigms can crowd out one another. But even Jerome Bruner might have agreed.

\(^73\) Tomkins, *A Common Countenance*, 2008, p332
his merit and credentials.\textsuperscript{74} As soon as he became an inspector of high schools in 1885, Seath wrote in his first report in detail how the physical conditions such as ventilation and lighting in the schools disrupted student health, and contributed to a widespread phenomenon where better students did worse on exams. He personally proposed alternative designs to window screens and school heaters, and even gave a kind of cost-benefit analysis to show skeptics that expenses are no excuse.\textsuperscript{75} To my knowledge, the onset of the school hygiene movement in Ontario is not something that is commonly connected to him. But in light of his early sensitivity to issues such as these, it would be in error to disconnect him from the hygiene tradition. The seemingly progressive regimens that he advanced contained elements that were very technocratic and medicalized; the fact that his proposals were not overtly pharmaceutical should not distract us from this fact.

As time went on, an increasingly medicalized curriculum did not overthrow the regime of exams, but rather intertwined with it. While testing operated sternly in the foreground, a clinic-like remedial system caught its reprobates in a kind of merciful net. In a time when the society was frequently horrified at the adolescent liberties that accompanied modernization, this net conveniently kept failing children inside the school system so that they could not get at the real world. These “auxiliary classes” continued to increase in scope and continued to refine its methods as time went on. Newer, supposedly gentler, pedagogical methods were experimented on these reprobate students, and if they fared decently then the pedagogies were deemed safe for the elect.\textsuperscript{76} It is no exaggeration to say that these disadvantaged students were imposed with a

\textsuperscript{74} Squair, \textit{John Seath and the School System in Ontario}, 1920

\textsuperscript{75} Government of Ontario. \textit{Report of the Minister of Education}, 1885. p152-172

\textsuperscript{76} Government of Ontario. \textit{Report of the Minister of Education}, 1937, p47
kind of degraded status that was quasi-religious in nature. Even during modernization it has proved difficult to fully disentangle health and morals, and in the context of a medicalized curriculum this really shows.\textsuperscript{77} Chief Inspector John Waugh’s remark about the dependency of “intellectual and moral efficiency” on the physical health of the student is a case in point.\textsuperscript{78} The treatment of internal dispositions as a subset of external behaviour served to undermine any serious rifts that could have developed between moral education and health education.

In the big picture, it gradually became possible to conceive of students as objects and phenomena, and education could assume the role of a science that studied their underlying laws. US educational psychologist E. L. Thorndike, whom in the early 1900s coined the concept of finding the “laws of learning,” was quite prophetic in this regard.\textsuperscript{79} When his student, Peter Sandiford, stepped into an administrative position in the Ontario ministry during the 1920s, prevailing social currents gradually made it possible to conceive of students as things that had certain properties, which could be determined if there were measuring devices such as examinations.

\textsuperscript{77} Gleason 2001 provides a good example where health education inextricably connects with moral education, where the line between healthy sexual behaviour and moral sexual behaviour is very much blurred in educating the child. One effect, intentional or not, of collapsing the cultural line between the body and the soul was that it enabled people to imagine schemes where the soul could be controlled through the body. For another account of how enlightenment can sometimes return to myth, see Milewski, Patrice. “The scientisation of schooling in Ontario, 1910–1934.” \textit{Paedagogica Historica}. Vol. 46, no. 3 (2010): 341-355.

\textsuperscript{78} Government of Ontario. \textit{Report of the Minister of Education}, 1920, p12; as quoted in Milewski, Patrice. “Positivism and post-World War I elementary school reform in Ontario”, \textit{Paedagogica Historica}. Vol. 48, no. 5 (2012): 728-743. Certainly it was not the first instance when Waugh invoked “efficiency” and erased the line between morals and intellect. In the previous year’s report Waugh remarked that moral and intellectual “progress” were physical traits that depended on age, and that anyone below fourteen cannot understand citizenship. See Government of Ontario. \textit{Report of the Minister of Education}, 1919, p5.

\textsuperscript{79} Tomkins, \textit{A Common Countenance}, 2008, p99
The longstanding drive for international competition

A perceived need to compete guided a lot of the curriculum ideas and policies throughout the history of Canadian education, and this happened on a number of levels. When the system was in its early years near the turn of the century, a debate over the merits of industrial education intertwined with a discourse of international economic competition. In tracing out how the pro-classics conservatives and the pro-science progressives clashed over curriculum ideology, Tomkins notes how in between the 1870s and the 1910s, there was an ongoing belief worldwide in the connection between a nation's education and its economy. The rise and industrialization of Germany raised a lot concerns in Britain and the United States, and they attributed this rise to the Prussian education system. There were growing concerns that teaching classical knowledge over industrial knowledge inside the schools was slowing down the society's ability to compete economically.

In the 1950s, the need to compete internationally became entangled with the onset of the Cold War. After the Sputnik incident in 1957, a wave of piecemeal curricular reforms took place, subject by subject, with mathematics at the forefront. It is certain here that competing internationally in the realm of the sciences is not separable from the drive to economic and political superiority. Even at the turn of the century, economic advantages went hand-in-hand with the ideas surrounding industrialization. With the onset of a space age that was also coupled with nuclear alerts, concerns with manufacturing and assembly lines shifted to more abstract fields dealing with electronics, radar, aeronautics, propulsion, atomic physics, and computing. Understandably the need for mathematics and abstract physics became greater, and it no longer

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80 ibid, p36-37
81 ibid
made sense to advocate in favour of industrial science but against algebra in the way Seath did during his own time. As the international competition involved more and more deadly artifacts, the race to abstraction only became more acute.

**Growing demand for abstract knowledge in the industrial complex**

In the 1940s, “technology” on the Canadian research scene largely referred to subsistence questions relating to food preservation and agriculture. Prior to 1951, the National Research Council of Canada has been centralizing all new knowledge within a single periodical called the Canadian Journal of Research. Every volume of the periodical had many sub-volumes marked by letter codes, each one representing disciplines such as physics, chemistry, technology, and so on. Section F at the time was called ‘technology’, which was mostly agriculture.

In 1951, the physics section of the Canadian Journal of Research split off and became its own journal. The volume number remained continuous with the old journal instead of starting fresh at volume 1, but it indicated that the different branches of scientific research increasingly saw themselves as being distinct from each other as they continued to push their own disciplinary frontiers. The bi-monthly Canadian Journal of Physics was highly technical, dealing with a variety of abstract theories and discoveries spanning the areas of energy,

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83 I am in no way implying that agricultural and food sciences were somehow more politically “neutral” than topics involving electronics, energy or spaceflight. Indeed, agriculture and food science have also in that period served as a cover for heavy-handed colonial agendas. See for example Mosby, Ian. “Administering Colonial Science: Nutrition Research and Human Biomedical Experimentation in Aboriginal Communities and Residential Schools, 1942-1952,” *Histoire Sociale/Social History* Vol. 46, no. 91 May 2013, 145-172. Nevertheless, as the external threats perceived by the country became increasingly electronic and aeronautical during the Cold War, it would be understandable why the nation-state might shift its gaze accordingly.
electromagnetism, material science, and so on. It was at the time completely undiluted by editorials, educational issues, advertisements, or political commentaries.

The journals of engineers (and teachers, for that matter) at the time was a different story, filled with advertisements, editorials, and other references to the everyday. At the very least, the advertisement part should come as no surprise. Certain branches of engineering have overlapped heavily with large size corporations. In Ontario, during the years between 1961 and 1964, only 58.7% of all the establishments in the manufacturing industries were sizable corporations. But this average is deceiving; once we zoom in to the relatively more high-tech subsectors of this industrial complex, this percentage shoots up to over 90%. This includes the petroleum energy industry at 98.9%, rubber (i.e. petroleum product) industry at 92.6%, mechanical industry at 91.9%, and electrical industry at 94.4%. This is in contrast to more organic industries including the food and beverage industry at 45.9%, textile industry at 69.2%, printing industry at 58.8%, and non-mechanical metal fabrication at 69.8%. There is a very interesting correlation here between the level of scientific sophistication and the level of corporate involvement. What this means is that large corporations were clearly overrepresented on the technological frontiers at the time. These areas, coincidentally or not, tend to involve slicker machines, harder physics, and lots of math.

In 1959, in Volume 5 of the *Canadian Aeronautical Journal*, W. A. B. Saunders wrote an editorial titled “The Changing Pattern of Engineering Education.” Saunders lamented how engineering work in the past have been burdened with the image of grimy manual work. He

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explained that this was due to economic downturns and a lack of technology, both of which caused companies to routinely relegate engineers to blue-collar posts and thus stamping them with an image that had nothing to do with their actual role in society. Here we see a clear effort to discursively cut ties between technology and menial labour by emphasizing their different levels of abstraction or mental work, which translates to a difference in prestige. Saunders reminded his readers that engineers were always a tier above the workers managerially, and it was only due to a lack of technological development and a lack of a favourable economy during the previous decades that prevented this order of things from becoming obvious. He goes on to say that all the misconceptions about the engineer was nevertheless turning around. The importance and prominence of abstract math and science is on the rise in engineering education. Universities in Canada are pushing for general engineering programs designed to fit all students in the general faculty, regardless of their specific branch. Saunders describes the contribution of the aerospace industry to these developments as follows:

Could it be that a general pattern of engineering education at the university level may shift towards engineering physics? … In a way, the aircraft industry has become the melting pot for Canadian Engineering graduates. Graduates from all Canadian Universities are thrown together in one common industry and, within months, it is difficult to tell the alma mater of the graduate or the area of specialization. 

In the same magazine in the same year, T. R. Loudon gives a much more detailed and personal account. Aeronautics, seen in the 1910s as a mere extension of mechanical engineering, became much more autonomous once the industry realized how much math and physics was required to keep progressing. The field also became more multidisciplinary as its problems grew
more complex, gradually bringing knowledge from electrical, structural, and chemical engineering into the fold. In 1934, the engineering faculty at the University of Toronto commissioned a number of subjects under the title “Engineering Physics,” which included math and physics courses taught at the level of abstraction equivalent to that of mathematicians and physicists. Loudon himself led the professorial team, indeed comprised of mathematicians and physicists, and served as the division’s first chair. In 1936, at Loudon’s suggestion, Aeronautics Engineering was introduced to the university as one of the upper year specialization choices of Engineering Physics. We can note in passing that this department in the University of Toronto, now renamed ‘Aerospace Engineering’, exists in exactly the same administrative structure even in the present day, as an upper year specialization choice embedded in a highly mathematical general curriculum, which has now been renamed Engineering Science.

At first glance, this may seem to be contradict my general narrative. Is it not true that most of the subjects are moving in separate ways in this time period? Is it not contradictory then, that subjects are merging in technological fields but drifting apart everywhere else?

First, it is important to keep in mind here that the development of the aerospace industry has been ongoing for several decades prior to the 1950s. These articles were written in the 1950s but they were describing what happened in the 1930s. During the late 1930s, there has been a similar development in the educational sector where the ministry of education wanted to achieve a “grouping together of like subjects”. While this may or may not point to a prevalent trend in social thought at the time, it is still a fact that this merging of technology-related subjects

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86 ibid


happened in the 1930s, whereas the drifting apart of disciplines happened later. Secondly, these are university subjects which are highly attuned to the industrial sector, as opposed to being high school subjects under centralized educational control. These developments can illustrate the currents in social awareness, scientific trends, and even educational thought, but they do not directly speak for the state of public education per se. Thirdly and most importantly, the biggest fallout from these developments is a growing social and intellectual realization that mathematics and abstract science were highly crucial to any competitive development of technology. Before the First World War for example, there was a demand for reconnaissance planes to at least fly faster than the navy frigates that they were trying to spy on. This created a large demand for advances in aerodynamics, which incidentally called for more rigorous regimens of math.89 Structurally similar shifts did not necessarily happen in other disciplines. Last but not least, subjects perceived as being interrelated can cluster into a bundle, even as these bundles drift apart from each other.

By the late 1950s, the teaching of science and math became even more of a concern for the military industrial complex. Even a few months before the launching of Sputnik, a 1957 article from the Bulletin magazine of the Ontario Secondary School Teachers’ Federation called attention to the increasing importance of math and science in schools. This article was submitted by a chief profile manager from the Chemical Institute of Canada. It called for a list of many proposals, including “a method for improving the understanding and co-operation between the school and the industry”, “set up a Company Education Department as part of the public relations program”, and “prepare and distribute vocational information films and pamphlets either direct or by financing the efforts of technical societies.” It also encouraged universities to

“co-operate with industry-sponsored and society-sponsored programs, and maintain a close liaison with secondary schools.” Thus at this time, a school-to-work STEM pipeline was already on the drawing board. Although the proposal was only directed at secondary schools and not elementary ones, the 1960s would see a set of changes beginning with mathematics that places every grade in the system from kindergarten to Grade 13 under the administrative domain of a single subject specialist. The pipeline to the labour market would almost literally begin at the cradle.

**The idea of human capital**

The roots of economics as a clear and distinct field can be traced back to the 18th century during the Scottish Enlightenment. This historical era is outside the scope of my current thesis, so I will refrain from any thick descriptions thereof and focus only on its ideological legacies and their relevant effects. The 18th century was the period in which British scholars pioneered a field that is today called classical economics. By the 20th century, concepts such as free markets, competition, and the “invisible hand” have long been placed within society’s repertoire of available ideas. But this does not imply that economic ideas have become outdated by the mid-20th century; on the contrary they continue to have profound impact, and the very age of these ideas can give them an aura of being incontrovertible common sense. Two of these ideas are of high relevance to the development of education. These are the twin notions of “division of labour” and “competitive advantage.”

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The early origins of the formal theories regarding division of labour is usually attributed to Adam Smith. To be sure, it is risky to attribute any historical thought to a singular “great person” and scholars have indeed pointed out that Smith did not work in an epistemological vacuum. But for the purposes of this thesis, we can say that an individual’s treatment of an idea became popular and affected future societies, without having to decide whether the origin of the idea was social or individual. This way we can still talk in an unparalysed manner about a history of ideas, without becoming serious adherents to any “great person” conceptions of history. In any case, the basic idea was that a high degree of specialization in skills and jobs within a populace was the best way to run an economy. Smith argued for this in three ways. First, if the workers repeat only a single task, then they would essentially be practicing for the same task over and over, which increases their efficiency because they get more practice. Conversely if workers are assigned to two different tasks, then the practice gained in doing one task will not make them more skillful with the other task, which is no good. Secondly, when people switch from one task to another, the switching itself inherently costs time. The more you multitask, the more time you spend switching between tasks. The more time you spend switching, the less time you spend working, and that is no good. Thirdly, if workers go through repeated motions like a machine, they might see enough of a pattern in their work to invent an actual machine for that repetitive task, which increases efficiency and progress. The potential for fallacy in these arguments aside, the sway that they held over social development since then is evidently profound if we consider the familiar image of the conveyor-belt assembly line in a factory a century and a half

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later, where each group of workers (and increasingly, robots) attend to only a specialized part of a product as it moves down the line.

Competitive advantage was a concept that was also developed largely by Adam Smith, although David Ricardo also furthered and modified this concept some decades later.\textsuperscript{94} The basic idea was that the best economic practice for each nation is to specialize in producing what they could most easily or cheaply produce, and then trade these goods with each other to achieve prosperity. In other words, countries ought to produce a product only if they can do so at a comparatively high quality or a comparatively low cost. However, as Sowell points out, Ricardo’s rendition differs from that of Smith in important ways. In Smith’s system, nations choose to specialize because it is more efficient. In Ricardo’s system, nations are inherently specialized because they are naturally different.\textsuperscript{95}

This detour into the history of economics outside the scope of our timeframe actually has important relevance once we think about what happens when these capitalist theories geared towards nations and markets are directed towards the human body. Broadly speaking, human capital theory is an umbrella term for any economic model that posits a causal dependency between a person’s education or training on the one hand, and their salaries on the other.\textsuperscript{96} Under such a framework, the human body itself is the object of an “investment”, and the monetary earnings of this person is framed then as a “return on investment”. Tomkins notes how burgeoning trends in educational policy in Canada already tended towards such thinking as early as 1951, when the Canadian Research Committee on Practical Education posited schooling as

\textsuperscript{94} Sowell, \textit{Adam Smith and the Modern Political Economy}, 1979, p3-18

\textsuperscript{95} ibid

\textsuperscript{96} See for example, Friedman, Milton. \textit{A Theory of the Consumption Function}. Princeton University Press, 1957.
something that “pays”. Tomkins also remarks that such individualistic and careerist ideas do have a macro level significance; for it was largely assumed that once a society becomes industrialized enough, further improvements to economic productivity was dependent on innovation, which in turn rested upon education.\textsuperscript{98}

Once an education system is placed formally within an economic framework, it opens itself to other economically-minded impositions from without. Classical economics during the Scottish Enlightenment dealt with the wealth of whole nations, and classical notions of competitive advantage and division of labour were originally framed as national and collective policies. But when the fiscal unit is not a nation but an individual, how will this new self-capitalism transform those classical notions?

The division of labour, in its classical formulation, already consigns individuals to singular, repetitive tasks, placing them in a perfect position to be replaced by machines. But even then, what is piecewise divided is simply a merchandise coming off a conveyor belt. Whereas when human bodies themselves become objects of investment, what is conceptually divided is the body of the student. Under the framework of self-capitalism, the three arguments for the division of labour takes on rather interesting forms. There would be three reasons to justify a schooling system parted into branches, with each branch taking care of just one piece of the child. First, these respective branches would obtain maximal “practice” when they deal with just one part of the child repeatedly. Second, the school would no longer waste time having to switch its focus from one part of a child to another part, which makes it more “efficient”. Thirdly, once a branch deals repeatedly with one part of the child to the point where an operational protocol

\textsuperscript{97} Tomkins, \textit{A Common Countenance}, 2008, p270

\textsuperscript{98} ibid, p251
emerges, that branch can be “automated” and replaced with technology. In reality, the first line of reasoning leads to a fragmenting of various departments inside educational institutions with entrenched procedures resistant to change. The second line of reasoning simply places the onus of finding the right department upon the student. Instead of the school spending time switching between different needs of the child, the child now spends that time looking for the right office and the right administrator for her or his needs. The third line of reasoning leads to a deskilling of the teaching profession, and the outsourcing of their jobs to rules and technology. Are these discussion too theoretical and speculative? Perhaps. But we need to soberly realize that all three consequences have already happened in reality, and are perhaps painfully familiar.

A competitive advantage is a kind of difference that has exchange value. When this notion is applied on a national scale, it is a question of the country’s natural resources, manufacturing expertise, and special technologies. Whether these things are of above average quality or below average cost, they would all be traits special to that nation, and these traits can be cast as goods with some exchange value. When complementary goods are exchanged with each other, we have a market of goods. But when this notion is applied to the body of the learner, what are the traits that have exchange value, and what kind of market do they form? Students would be encouraged to get better at one skill, or a very limited number of skills. Either they can deliver these skills at higher quality, or they can develop these skills at lower cost. But how can one get them to trade these skills? How can one set up a market of skills? One way to do this is to demarcate skills in a way such that no single expertise can amount to subsistence without exchange. In other words, the sum of existing knowledge would have to be broken up to the point where no single expert can make a living without scratching another expert’s back. But a consequence of this system is that if cartels were to emerge in this knowledge economy, and if
they become motivated to steer the prices of various knowledge and skills, then the worth of any knowledge can become plastic.

Together, these twin trends of placing political economy inside the body of the learner creates a picture where the human is living commodity manufactured by education and training, and where human skills are diverse in the same way that commodities are diverse. Conceptually, the shift from the 18th century political economy of goods to the 20th century bio economy of knowledge can be depicted in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Political Economy</th>
<th>Bio Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Advantage</td>
<td>Every county should specialize in goods that they can most easily produce, either in terms of higher quality or lower cost</td>
<td>Every person should specialize in skills that they can most easily do, either because they perform them better or learn them faster</td>
</tr>
<tr>
<td>Division of Labour</td>
<td>Every line of work in a factory should focus on producing a specific part of a merchandise</td>
<td>Every branch of a school system should focus on producing a specific part of a child</td>
</tr>
</tbody>
</table>

Now, one could argue that “competitive advantage” under the bio economy is not really a new idea, because it more or less re-inscribes the “division of labour” under the political
economy. In a way this is true, which goes to show how old this impulse towards specialization really is. But there is a technicality here. As Arrow discusses at length, Adam Smith formulated the case for a division of labour in a way that did not attribute differences to inherent nature.99 A few decades later when David Ricardo formulated his case for specialization, differences between production roles were attributed to nature and taken as a natural given. What Smith treated as a matter of choice Ricardo treated as a matter of nature, and this new formulation of specialization left little room for agency and self-determination. Arrow argues that it is this latter treatment that enjoyed more popularity in later centuries, although in my empirical findings the rhetoric of choice have often cropped up in the Ontario Ministry of Education Reports as well throughout the 20th century. The nature-based treatment no doubt became increasingly easy to imagine as the curriculum became increasingly medicalized in the 1920s and 1930s, even as the official discourse continued to use a rhetoric of choice below the policy level. But as disciplines began to drift apart in the late 1950s amidst a fascination with giftedness and human selection, what was decidedly new was how the division of labour intersected the bio economy. It would not be so easy to wholly go without at least a rhetoric of choice.

Does the fragmented state of the subjects have an origin?

It is very crucial here to explicitly note something of great conceptual importance. On the surface, categorizing and dividing children on the basis of their preferred subjects seems like a practice that has always existed, which appears at first glance to undermine the search for an “origin” for this conception. We saw a clear division between the humanities and the sciences as

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early as the 1870s, in light of which nothing seems to have changed. We saw a clear division between public schools and industrial schools at about the same time, dividing unruly versus docile children, which again vaguely paints the feeling that nothing has changed. We saw the industrial school issue morph into a divide between literacy education and trades education, pitting reading and writing versus manual subjects; this again vaguely resembles the situation later. We see the unruly versus docile antagonism re-surfacing in the discourse around gifted children. Again nothing seems to be new. Even the content-versus-children debate has surfaced as early as the 1930s and in fact owes its roots way back to American pedagogical progressives.¹⁰¹

Yet none of these dichotomies can quite exactly serve as a complete illustration of the topic at hand, which is the question about locating the ability for a particular set of subjects in the body of the child. What we had identified so far are merely some ingredients to our problem, amongst others. First is the longstanding dualism between the humanities and the sciences, which provide two systems of knowledge that are quite sundered from each other. Second is the longstanding dualism between elect and reprobate students, which reinforces an impulse to segregate people and place a value on their heads. Thirdly is a century-long tradition of testing, coupled with a growing awareness of its function as a scientistic tool to conceive students as phenomena, to measure them, and to assign them values. Fourth, this regime of testing then combines with a human capital ideology so that students are made to see themselves as a bundle of skills. They can then be encouraged to invest in the skills that are already ahead of the pack. Fifth is a decision by a part of the technological community to part ways with its menial image

¹⁰⁰ ibid
¹⁰¹ See for example, Kohlstedt, Teaching Children Science, 2010; Tomkins, A Common Countenance, 2008
by embracing science and math, and concurrently drawing closer to the managerial echelons of the corporate industrial complex. The point of interest happens only when these ingredients combine: when the value on the student's head begins to signify her or his affinity for a particular body of knowledge, when there is a regime of measuring tools to obtain the values that the system needs, and when there is sufficient corporate involvement to promise “returns on investment” for the subjects who invest in their higher affinities.
Section 3: Key developments from the late 1950s to the 1970s

**New forms of Elitism**

As the Cold War set in, a new form of elitism emerged that was unlike those conservative backlashes from before. In 1958, Minister of Education W. J. Dunlop declares the onset of a new concern, one that is directed not to underperforming children, but to gifted children. He talks about how many of these children were identified in the past year and placed together into separate classes, where they would be given material that was supposedly more fitting for their higher talents.

In the 1958 report, an interesting text appeared on the opening page, tellingly titled "Programmes for Gifted Children." In his approving description of such a development, Minister of Education W. J. Dunlop remarks that there exist pupils of “unusual mental ability...often accompanied by creative talents, advanced physical development, and emotional stability”. He notes how teachers in the past have always had to encourage these students “on an individual basis”, but now with “improved methods and materials for instruction and testing”, these students can now be gathered up and taught collectively. He praised how in 1958, between five elementary school boards, “20 segregated classes for gifted pupils” had took place. These pupils were identified and chosen using ability tests, to carry out extracurricular “research” on their own, and present their findings in these segregated classes “in an orderly manner.” The minister hoped that these measures would cause talented children to contribute even more to society in

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the future. At the time of this announcement, a new elitist phase in Ontario education was well in motion.

In 1960, mathematician A. J. Coleman, a professor from Queens University who was serving as the President of the Ontario Mathematics Commission, made an educational article in the *Canadian Mathematical Bulletin*, a periodical otherwise dedicated wholly to technical mathematical proofs and procedures. Coleman deplored a number of things about math education in Ontario. [1] There was said to be a lack of teachers who specialized in teaching the subject, [2] a relatively slower coverage of content compared to other jurisdictions in the world, [3] a lack of attention paid to well-performing students, [4] a rote-based curriculum that actually made life easier for underqualified teachers, and [5] a one-size-fit-all curriculum that forced the slower children to memorize and drove the faster children to boredom. Coleman furthermore rejected what was then a status quo, where students with different levels of aspiration and need for mathematics beyond high school were fed the same kind of math during their high school years. He called for a schema where:

In Grade 13 there should be one course, Mathematics A, designed for students for whom this would be a terminal course and in which the examination would not probe too deeply, and two additional courses, Mathematics B and Mathematics C, designed for future mathematical practitioners in which the examiners would test for mathematical power and maturity.103

These remarks amount to a direct call, from a “content expert” no less, to create a separate dedicated pathway for the mathematically ordained. Edwin Guillet, in his historical

account of the Ontario Educational Association, held a similar position about education in general, saying that the first century of Canadian education has served commoners, but the emphasis should shift rightly to the elites in the years to come. He even made explicit mention of the Sputnik incident, citing a need for “men and women of mind.”

The Robarts Administration and the Reorganized Programme

In 1959, J.P. Robarts replaced Dunlop as the minister of education. Interestingly in this year’s ministry report, physical education, history and geography, and art curriculum all received some overhaul, whereas the areas of math and science were still being revised by certain committees. Robarts reported that a new wave of textbooks tailored to Canada and more specifically Ontario were being prepared. New Canadian-made History books for higher grades and new English books for elementary school have allowed the removal of older American textbooks in these areas, and similar developments were in motion in the areas of geography and the sciences. Meanwhile on the matter of auxiliary education, the service was beginning to expand into the more rural jurisdictions. The impetus of auxiliary education have become twofold. On the one hand it kept up the effort to expand remedial services to the rural areas, and on the other hand it was beginning to think about how to create structured programs for the gifted. But what was perhaps the most iconic curricular legacy of the Robarts administration was the Reorganized Education Plan.

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104 Guillet, *In the cause of education*, 1960, last page


106 ibid, p9
In 1961, Robarts announced the Reorganized Programme, often dubbed by the media of the day as the Robarts Plan, which was to be implemented in September during the following year. The plan involved a new high school curriculum that was intended to stream students along one of three paths: [1] Arts and Science, [2] Science, Technology, and Trades, and [3] Business and Commerce. The government in 1961 circulated a pamphlet about the plan to student parents that included a diagram drawing the three tracks that the students may find themselves funnelled along. There were minor branches splitting off from the three main trunks, signifying a normalized depiction of dropping out. Part of the ideology behind the new curriculum was to give students a certificate for having completed at least some grades even if they drop out after Grade 10. Within the pamphlet, the government argues the growing importance of education to an increasingly modernized society, how it would not do for the populace to stay at the same level of education going forward, and how in the status quo too small a percentage of high school students finish their final grade. Low credential jobs, the reports said, are all becoming automated, and this is going to be a mismatch with a status quo that has been seeing such a high rate of turnover.

It is interesting to note that objectively speaking, the mere act of giving a formal grade-specific certificate to students who will not complete Grade 13 does not constitute a serious effort to raise the education level of the general population. This framework alone does nothing to intervene in the welfare of students, and does not prevent students who are slated to drop out from doing so. But ideologically speaking there could be something important in this move. In a system that does not give out these redundant certificates, there is little formal difference between a Grade 9 dropout and a Grade 10 dropout from the system’s point of view. Both reprobates of the system would be deemed invalid, but immeasurably so.
On the other hand, in a system that gives out these seemingly empty certificates, the quantitative point at which these reprobates exit the system is recognized and marked. The system has now extended its domain of measurement to include even those whom exit from it. I am highlighting such an interpretation of this event because it illustrates the extent to which the regime of measurement has permeated the school and how extensive it was striving to become.\textsuperscript{107} The system is ever coming up with more innovative ways to bring the body of the student under the domain of measurement. As those decades unfolded, this drive to discern the properties of the student body would have more direct consequences.

\textbf{Ascendancy of content-centred curriculum}

When Robarts reported in 1959 that curriculum was undergoing overhaul subject by subject, he noted in particular that reviews and revisions of math and science subjects were amongst the last ones that were still in progress.\textsuperscript{108} In fact, the most recent incarnation of the drive to reform math and science teaching back then began in 1957, when the Ontario Teachers’ Federation formed the Committee on Mathematics and Science.\textsuperscript{109} This committee then grew into the Ontario Mathematics Commission. The Commission operated independently even as it received funding from the Teachers’ Federation. It is this commission that planned new curricula and textbooks for mathematics. Moreover, officials from the Ontario Department of Education took part in it as well. Fleming notes how this was a major departure from the Department’s past

\begin{itemize}
\item \textsuperscript{107} Foucault has outlined in detail how digitizing and sharpening a hierarchy will inherently have disciplinary effects. See Foucault, M. \textit{Discipline and Punish: The Birth of the Prison}. Vintage Books. 1995. p170-194
\item \textsuperscript{109} Fleming, \textit{Education: Ontario’s Preoccupation}, 1972, p192-196
\end{itemize}
practices, which was a top-down prescription of textbooks decided in “relative isolation”. At about the same time, there was another joint committee formed between the Toronto Board of Education and the University of Toronto, which also attempted to explore the making of a new curriculum. The resultant recommendations reversed the suggestion against teacher specialization during the 1937 curriculum reforms. This was partially due to the fact that, when the commission met together to draft curricula, high school teachers deferred to professors and elementary teachers deferred to both. When professors dominated the discussion, subject matters rather than students came to the fore.

Fleming’s detailed study of this period bears quoting at some length, as it illustrates how the math curricula was far from the slowest to accept reform. In many ways, the math reforms, despite its seemingly slow start in Robarts’s first ministry report, actually had the most staying power going into the 1960s. In fact, even as the education system underwent change again during the Hall-Dennis period in the later 1960s, the subject-specific model adopted by math became a template for other subjects:

In an article in the Ontario Mathematics Gazette in 1966, J. F. Kinlin indicated some of the most significant changes in the departmental approach beginning in 1956. Although he was dealing specifically with mathematics, many of the developments he referred to had a much broader application. In some ways, in fact, new approaches in that subject foreshadowed progress in curriculum reform in general. Kinlin identified the adoption of the policy in late 1956 of appointing staff inspectors for academic subjects as the first

110 ibid. p 192

111 Scholars such as Patrice Milewski would be quick to point out that a reversal of the 1937 policies does not mean that the impact of those policies on the history of thought, whether intentional or not, ceased to reverberate. Of course I agree; but we should be mindful of how the cultural effects of the 1930s combine with the legal policies of the 1960s. This I argue is what allows the importance of the 1960s to come to the fore. See Patrice Milewski, “The Little Gray Book: Pedagogy, Discourse, and Rupture in 1937.” History of Education, Vol. 3, no.1 (2008): 91-111.

112 Fleming, Education: Ontario’s Preoccupation, 1972, p192-196
significant departmental change of the period. Some hint of future efforts to integrate elementary and secondary education was provided by this own experience in that he was the first elementary school inspector to be appointed as an inspector of an academic subject at the secondary level. Integration of the two levels became a stated objective as early as 1960. Two years later, a single specialist became responsible for mathematics in the full range of grades from kindergarten to Grade 13.\textsuperscript{113}

What is happening in this course of events indicate at least three ruptures with the past. First, teaching math began to split off from teaching. The fact that the teaching of math (and science too, at the onset) spawned a single-issue commission in 1957 indicates that math and science education was becoming a particular issue that could not be handled by education per se. With a wedge thus driven, math teaching and teaching per se were poised to become separate areas of inquiry, and one side can find it easier to immunize itself against developments that happen on the other.

Secondly, Fleming’s observation is of great importance in that the control of the curriculum was being ceded piecemeal from centralized officials to subject experts. Prior to this age, even when conservative policy makers exalted the primacy of subject matter in some way or another, the teaching of whatever subject remained a question of schooling. The subject may have taken precedence over the child, but under the old centralized system at no point was it acceptable to say that the subject took precedence over the school. Thirdly, what is emerging is a continuous and cumulative view of subject knowledge. Tomkins notes the importance of the educational philosophies of Jerome Bruner, who believed that every field had its inherent structure, and the basis of teaching any field was to teach this inherent structure.\textsuperscript{114} Such a view


\textsuperscript{114} Tomkins, \textit{A Common Countenance}, 2008, p265-266
at the time, Tomkins notes, was highly attractive because it promised to tame the exploding volume of knowledge down to a set of essential rules.\textsuperscript{115}

It is philosophically significant to notice here that under this framework, “failing math at Grade 3” becomes “failing to grasp the essence of mathematics”. Failing a grade in a field of inquiry now signified failing the field. A singular trait, “grasping the essence of the field”, determined success. When success in a whole field rides on a singular trait, it then becomes that much easier to imagine this trait to be “talent”. Kohlstedt’s historical study of science education in the American context will remind us that E. L. Thorndike held a very similar position earlier at the turn of the 20\textsuperscript{th} century, believing that science was a subject fit for only an elect few with the proper traits.\textsuperscript{116} The work of Bruner thus updated the views of Thorndike by bolstering this line of thought even further using the explosive growth of knowledge as a new justifying device.

**The Hall-Dennis Report and the New Credit System**

In 1965, Ontario formed the Provincial Committee on Aims and Objectives of Education, and this marked a reversal of the conservative climate in education that has dominated for over twenty years. The committee released a full report on the education situation in the province in 1968, titled Living and Learning. As the committee was chaired by Justice Emmett Hall and Lloyd Dennis, the public often referred to the document as the Hall-Dennis report. Notably, Justice Emmett Hall was a member of the Supreme Court, and was also the driving figure behind the implementation of Canada’s public health care system in the same year. Not surprisingly in

\textsuperscript{115} ibid

\textsuperscript{116} Again, see Kohlstedt, *Teaching Children Science*, 2010, p171 and 180
light this, the content of the Hall-Dennis report was highly progressive, pushing vigorously for a child-centred curriculum that favoured socialization over discipline, an integrated menu of academic subjects that was not to be fragmented, and stressed the role of the teacher as a guide rather than an authority.\textsuperscript{117}

John McCarthy, Deputy Minister of Education, took in the recommendations of the report very earnestly. Eager to produce a new curriculum that was far less rigid and accorded far more freedom to the students, McCarthy began pushing for a highly flexible credit system that reversed the rigid streaming doctrines of the Robarts Plan.\textsuperscript{118} Historians are in broad agreement however, that the recommendations per se probably were not the main driving force behind the progressive change in the late 1960s. Teacher unions were more vigorous than before, and students could obtain more sympathy from a general population that desired change after more than twenty years of conservatism. The public symbolism served by Hall, who was also the main advocate of public health care at the same time, coupled with the general progressive tone surrounding the report, did more to galvanize change than the particular policy recommendations within the report proper.\textsuperscript{119}

The new credit system was highly flexible. Minister William Davis officially announced the end to the Robarts plan in 1969, ushering in a new system that only had very loose boundaries between four general areas of interest: communications, social sciences, pure and applied sciences, and arts. Beyond the need to fulfill a certain number of credits within each of

\textsuperscript{117} Stamp, \textit{The Schools of Ontario}, 1981, p221

\textsuperscript{118} ibid

\textsuperscript{119} Tomkins, \textit{A Common Countenance}, 2008, p279
the four areas, student choices were more or less free.\textsuperscript{120} It should be mentioned here in passing that the concept of a credit system in itself was not new. The credit system was pioneered by the Carnegie Foundation during the 1930s, and Robarts himself has spoken of plans to implement some kind of credit system as early as 1959, which according to him “could be far-reaching in effect”.\textsuperscript{121}

The important aspect of the new credit system under the Hall-Dennis progressive era was that it was very flexible, and the four ultra-broad subject divisions served as the only mechanism for order. It can be seen here that broad subject divisions were considered unproblematic by the progressives at the time, and this not only reflected a similar mentality by the progressives during the 1930s, but it was also an unexamined move that would have consequences later on. In any case, this new system would not last, as core courses would gradually creep back into the requirements as the climate of the times become more conservative again in the following decade.

However, the subject-based credit system itself was here to stay, and this alone amounted to profound effects on the ways in which societies conceive of knowledge. More importantly, it marked a point where progressive education was no longer explicitly opposed to content-based specialization. In the 1969 curriculum, “literacy” was not explicitly involved in any of the four credit groups. Literacy in general and mathematics in particular no longer served as a competing category against the sciences in the public school system.

Notably, an immediate fallout of the new system was an enrollment decrease in foreign languages and history, and an increase of enrollment in science, arts, social science, and

\textsuperscript{120} Stamp, \textit{The Schools of Ontario}, 1981, p221-222
vocational subjects. Enrollments in math and English stayed about the same.\textsuperscript{122} In light of such evidence, science still seems to be receiving some kind of anti-vocational stigma even as late as the 1960s. It is only after the strict academic-vocational divide of the Robarts Plan has been dismantled that students began to be willing to take more sciences.

\textbf{Response of Ontario math educators to the decade of change}

The political pendulum of the 1960s elicited a good deal of engagement from math educators in Ontario. The attitudes of math educators towards political reform can be gleaned from the \textit{Ontario Mathematics Gazette}, which was a magazine made specifically for math education in the province. In 1962, in the debuting year of the Gazette, there was petition-like article which featured many mathematical commentators from prominent American universities, who signed their names at the end after addressing Canadian math educators on the state of Canadian math teaching.\textsuperscript{123} There is a paragraph near the beginning that is worth quoting at length:

\begin{quote}
It would, however, be a tragedy if the curriculum reform should be misdirected and the golden opportunity wasted. There are, unfortunately, factors and forces in the current scene which may lead us astray. Mathematicians, reacting to the dominance of education by professional educators who may have stressed pedagogy at the expense of content, may now stress content at the expense of pedagogy and be equally ineffective. Mathematicians may unconsciously assume that all young people should like what
\end{quote}


\textsuperscript{122} Stamp, \textit{The Schools of Ontario}, 1981, p222

present day mathematicians like or that the only students worth cultivating are those who might become professional mathematicians. The need to learn much more mathematics today than in the past may cause us to seek shortcuts which, however, could do more harm than good.\textsuperscript{124}

The passage certainly sounds very progressive; it warns of gravitating too much towards content at the expense of teaching, it cautions educators against pedagogies that are based on selection, and is critical towards cramming large volumes of knowledge. Indeed, the article advocates a mathematics curriculum that addresses the needs of all students, connects math to other subjects, connect various concepts within math itself, and even a pedagogical inclusion of a history of mathematical thought. But upon closer examination, other suggestions might give pause to some pedagogical progressives. In total, the article proposed seven suggestions, some perhaps more reassuring than others:\textsuperscript{125} [1] mathematics for all, [2] knowing math does not count until one can do math, [3] math should be more closely related to the physical sciences, [4] math reasoning should not just be the deductive kind, [5] favour historical progression rather than logical progression in the teaching of mathematical ideas, [6] a reaffirmation of traditional mathematical subtopics such as geometry, algebra, and calculus, and [7] a guarded tolerance of modern subtopics such as sets and groups, topology, complex numbers, etc., insofar as the increased abstraction coming with them can make math appear more unified. So overall, such an attitude combines a commitment to universal education with a holistic attitude, some historical sensitivity, and yet at the same time a behaviourist view of learning and an adherence to traditional “basics.”

\textsuperscript{124} ibid, p5

\textsuperscript{125} ibid; the seven points advocated by the long list of authors comprises the main body of the article, of which “mathematics for all” was the very first item
Note further that mathematics for all did not necessarily rule out differentiated content. In an editorial in the same issue, R. B. Gwilliam conveyed the remarks of A. J. Coleman, a professor at Queen’s University who was the former president of the Ontario Mathematics Commission. Very notably, Coleman called for greater emphasis on “enrichment programs for superior students,”¹²⁶ and this call for a separate pathway for the mathematically elect was completely in line with his earlier remarks during 1960 in the Canadian Mathematics Bulletin, a professional periodical geared more towards mathematicians.¹²⁷ Furthermore, it should be noted that while educators called for integrating math with other subjects, the “other subject” held in mind was mostly natural science. In the words of the original article:

In its cultural significance as well as in its practical use, mathematics is linked to the other sciences and the other sciences are linked to mathematics, which is their language and their essential instrument. Mathematics separated from the other sciences loses one of its most important sources of interest and motivation.¹²⁸

Implicitly, math is framed as a science, and this framing is justified on communicative as well as instrumental grounds. But is math ontologically a science, or a tool for science, or both? While this is unclear, what is made clear is that the biggest point of doing math is to do science.

On the whole, the questions raised in the first volume of the Gazette forecasted questions that would be continuously debated in the decade to come. On a deeper level however, it is worth asking how math educators perceived the nature of these political debates, especially once the


¹²⁸ Ahlfors et al 1962, p6
Hall-Dennis report appeared on the scene later on in the decade. This line of thought can be divided into several questions. Firstly, there is the question of whether the increasing abstraction of math content was perceived by educators as progressive, reactionary, or neutral. We can already see that around the period of the Robarts Plan, the math education scene was very uneasy at the newer, more abstract approach to mathematics. The petition article in 1962 was not the only voice expressing concerns about abstraction, and debates over this continued well into the 1970s.\textsuperscript{129} What is interesting is that the abstract approach was often called “new”, while the concrete approach was often called “old.” While the new approach was sometimes castigated for catering only to students who aspired to do highly advanced math in their careers, it was also often acknowledged by the same critics that the new approach held the promise of giving math a more holistic presentation.\textsuperscript{130} Secondly, there seem to be some contradiction between the calls for a mathematical curriculum geared towards all children, and the calls for a curriculum geared towards “superior children.” Even though the Ontario Mathematics Commission was presided by an advocate of giftedness, the \textit{Ontario Mathematics Gazette} that promulgated the commission’s ideas frequently published views that overturned abstract math in the name of a mathematics for all. Thirdly there is the question of how the Hall-Dennis report was perceived by math educators once it came around.

Generally, social historians see the report as being radical in its rhetoric only, affirming everything that was standard to a pedagogically progressive doctrine without much clarity on the

\textsuperscript{129} See for example, Sawyer, W. W. “The "new math" in schools - should we extent it, amend it, or abolish it?” \textit{Ontario Mathematics Gazette}, Vol. 13, no. 2 (1974): 105-115.

level of content or policy. At first glance, although the mathematical reception was more negative, it was not too far away from the social historical assessment. On the part of the mathematics educators, some felt for instance that the Hall-Dennis report, in pitting an “authoritarian, regimented, fact-stuffing system” against the “needs of the individual child”, made the student-content dichotomy too easy of a choice. A complicating issue however, was that when the Hall-Dennis report burst onto the scene in 1967, the math side of education was already embroiled in the debate across not one but at least four different binaries: the content versus the student, the concrete versus the abstract, procedural learning versus discovery learning, and open mathematics versus gifted mathematics. The fact that the Hall-Dennis report was sometimes grouped together with the position of Jerome Bruner in this field reveals how the terms on which mathematicians interpreted educational politics was actually quite different from their counterparts in social history. When the Hall-Dennis report emerged, it was enlisted as a participant in existing debates; and even though the Robarts Plan doctrine changed to the Hall-Dennis doctrine for education in general, the particular terms of debate within math education were not redrawn in response. It can also be noted here that the conservative-progressive divide in math at the time could not be framed neatly as “old” versus “new”, and the

131 See for example Tomkins, A Common Countenance, 2008, p276
133 See Staal 1970; and Steel, G. G. “Where are we going? Why are we going there? And have we got to the right place even if we get there?” Ontario Mathematics Gazette, Vol. 5, no. 2 (1967): 46-55.
general tones in the *Gazette* did not for the most part overtly confuse one dichotomy with the other.

Lastly on this matter, it is of some significance that the debates within math education at the time, at least judging from the *Gazette*, were not bitter or polemical. Each of the articles examined, whether progressive or not in their tones, was implicitly committed to teaching mathematical content. Deliberate or not, this was a unifying point for the various positions that different authors had taken up, and it is possible that this commitment to “content” is what prevented the debates internal in math education from becoming as heated as general debates in education per se. The wide ideological chasm between positions advanced by conservative critics such as Hilda Neatby\(^{138}\) versus the liberal directions taken by Lloyd Dennis and Justice Hall seems to dwarf any subterranean contradictions that existed inside the discourse of mathematics education. It is beyond the scope of this paper to theorize how the common ground provided by the subject matter points at a functionalist explanation for the invocation of “content,” but this direction might be open to other investigations.

**OSR and Guidance Services: present surveillance for future living**

The year 1959 saw the formal implementation of the Ontario School Record System (OSR), a system of documents that served as the official cumulative record of any student under its gaze. Workers in the guidance system were contributing towards an initiative called the Carnegie Study, which Robarts predicted could be “far-reaching in effect”.\(^{139}\)

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\(^{138}\) Neatby was involved in the conservative federal Massey Commission on education in the early 1950s.

In the following year, the minister would remark that the guidance system was serving a body of parents and students that were increasingly interested in educational and occupational information. There is more to this truism than meets the eye, because when a single department disseminates knowledge and services on two different areas, it makes it easier for its clients to associate one area with the other. In the 1960 report, Robarts explicitly says,

An ever-increasing interest in obtaining education and occupational information in evident on the part of students and their parents. This demand has been matched by willing action on the part of universities and other educational institutions, as well as of business, industry and service organization, in making available much helpful information to the school. The value of this co-operation of school and community in providing students with authentic information regarding further education and vocational opportunities is not widely recognized.140

Thus in a way, intentionally or not, the guidance services functioned as an advertising agency for the universities and the industries. It was the role of the guidance department to disseminate information on the branches and disciplines that existed in a university, as well as information of the categories of jobs in the market and the qualifications that they might demand. Through guidance, these higher external agencies can make long-term demands on students. Through guidance, these demands can be reconstructed in ways that are easier to understand and internalize. There have been long-standing calls about the importance of connecting school life to real life since the times of Dewey, who once said that school is a place for living and not a place to prepare for future living. Although “future living” is obviously something that has stubbornly remained in the system, efforts to at least connect future living with school life were

nevertheless in place. Here we might say that an economic life at the time was seen as a kind of “future living”, and it was the role of guidance to minimize its ruptures with school life.

Moreover, it is important to note that a rudimentary guidance infrastructure was already well in place in Ontario by the early 1950s, although it leaned heavily towards vocational guidance. In as early as 1952, the supplementary materials given by the Ontario College of Education to vocational guidance workers included a booklet-format catalogue that marketed long lists of various ability, aptitude, and intelligence tests, often geared towards particular professions. This shows the heavy entanglement between aptitude testing and vocational orientation in prevalent social thought, and reveals a framework that casts the labouring body as an object possessed of certain traits inside of it. Of particular interest is a test called “Engineering and Physical Science aptitude test” ever since the first issue. In the words of the test’s own developers:

> This test is designed to predict success in training for work in engineering and physical science fields. Consists of six sections: mathematics, formulation, physical science comprehension, arithmetic reasoning, verbal comprehension, mechanical comprehension. Norms are presented for several occupational and school groups.

Note here that the nature of the test is not a retrospective evaluation of already-mastered facts; it is a projective evaluation that seeks to predict future success. It is not testing for knowledge, but for traits. Thus as early as the 1950s, the belief that STEM success was a

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141 Physical copies of these booklets can be found in the OISE archives at the University of Toronto; I am grateful to the school for allowing me inside the archive room on a regular basis.

question of traits was already present in the guidance system. Interesting also is that starting in 1955, the annual booklet began to include a “glossary of measurement terms”, which referred to the frequently used technical words that crop up in human measurement discourse. One such word is “aptitude”, for which the given definition is worthy of consideration:

aptitude. A combination of abilities and other characteristics, whether native or acquired, known or believed to be indicative of an individual’s ability to learn in some particular area. Thus, “musical aptitude” would refer broadly to that combination of physical and mental characteristics, motivational factors, and conceivable other characteristics, which is conducive to acquiring proficiency in the musical field. Some exclude motivational factors, including interest, from the concept of “aptitude”, but the more comprehensive use seems preferable. The layman may think of “aptitude as referring only to some inborn capacity; the term is no longer so restricted in its psychological or measurement usage.

At a glance, it would appear as though the conception of aptitude no longer implies genetic determinism, and that therefore the invocation of this concept has no inequitable overtones. But on a philosophical level there are still pitfalls. Even if aptitude is expanded to include nurture as well as nature, it can potentially legitimize an aptitude-based rejection of the poorly-nurtured child. While it is true that the invocation of aptitude in light of this is rather complex instead of being one-sidedly malicious, whether this development is good or bad depends on whether punitive evaluative structures surrounding “aptitude” is amended. In other words, unless the more comprehensive definition of aptitude changes the educational orientation

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143 Of course as mentioned elsewhere, this mentality per se was not new in the world; but when Thorndike uttered similar sentiments in the American context at the beginning of the century, guidance infrastructure was not yet in place. I am of the view that new institutional structures do not automatically inherit old mentalities; whether or not they do in any given case is an empirical question.

144 Ontario College of Education. Guidance Material 1955-1956, p63

145 ibid
from one of selection to one of intervention, such an expansion of mere definitions do not entail a gain in equity. Acknowledging the significance of social factors on student achievement is educationally progressive only if it is accompanied by an impetus to address those social factors. The counselling infrastructure in light of this, even as it propagates a discourse of human selection, has the power to curtail the punitive effects of human selection practices by addressing and intervening in the social barriers to student achievement – should it choose to do so.

To be more explicit, it is too dangerous to wholly disparage the guidance services simply on these grounds that it created a disciplinary structure of surveillance; guidance could be construed as a positive development is many other ways, not the least of which was that they actually seem to have helped some children better their lot in life. Even the function of vocational guidance specifically can be cast in a positive way. In light of how the businesses cooperating with the schools were seen by Robarts as being part of the “community,” getting a job was not just seen as future living but as real life. The idea that engaging with businesses was equivalent to engaging with the real world was in fact a longstanding perception in higher education that can be traced back to at least the turn of the century.\textsuperscript{146} This was also true in a more grim way, since during the first half of the 20th century dropouts were a constant source of concern for the system. It is well-noted that an impetus towards “social control” existed ever since the nascent days of the progressivism,\textsuperscript{147} and thus even if the potential dropouts were not


\textsuperscript{147} See for example, Tomkins, A Common Countenance, 2008, p98; even before the progressive period of the 1930s, Dewey’s ideas enjoyed a modicum of traction in Canadian normal schools (i.e. teacher’s colleges) since his visit to Canada in 1901. However, Canadian educational discourse at the time framed Dewey’s call for democratic
provided a worthwhile education, there would an impulse to sequester them so that they could not roam elsewhere. As the curriculum modernized, it gradually added courses that were thought to be of interest to some of these students, so that they might not only remain inside some kind of school system but also learn something that could make them better equipped in society.

Still, for the better part of the early 20th century students dropped out on quite a large scale. In 1957, 72,063 students enrolled into Grade 9,148 while in 1961 the number of Grade 13 students numbered 21,482.149 That is a very high turnover rate seen from a present perspective. If all those students who dropped out had some kind of resource to consult as to the kinds of jobs they might get, a counselor to give them some orientation, and so on instead of a hardline structure that kept them sequestered, in a vacuum at least it does not sound so bad. A survey done by the Canadian Counsellor periodical in 1969 suggests that about one-third of the students were not using guidance services at all, one third used it exactly once a year, and one third were using it more frequently.150 The survey was limited in scope and did not take place in Ontario, but at least it suggests that the service was reaching out to a good number of adolescents, many of whom at the time, as we noted, were not slated to pass high school.151

education into a call for social control. Allison Prentice has outlined explicitly that early school promoters in Canada feared that the country will fall behind, wanted both social order and material growth, saw no contradiction between those wants, and acted upon such wants by creating the schooling system. See Prentice, Allison. The School Promoters. University of Toronto Press, 2004. p46.

151 R. M. Stamp has illustrated how prior to the Second World War, the majority of the young adult population was not even attending school. See Stamp, R. M. “Canadian High Schools in the 1920s and 1930s: The Social Challenge to the Academic Tradition. Historical Papers, Vol. 13, no. 1 (1978): 76-93. It would make sense then, that as attendance swelled in the after-war years, the schooling system saw the need for some mechanism to normalize school life in the minds of the young.
We also have to keep in mind that the steering effects of guidance upon student vocational orientations may not wholly be the effect of deliberate manipulation on the part of counsellors, and that intervention was not necessarily negative even when it did exist. In 1969, Quebec high school guidance counsellor J. A. H. Fraser published a study in the *Canadian Counsellor* magazine showing that about a third of all students who use guidance services browse various educational and vocational magazines lying around in the waiting room.\(^{152}\) Thus the guidance office was a space in which a child can be exposed to “counselling” from sources other than the counsellors physically present.

While interaction with counsellors is a structured verbal experience, there is also a more liminal visual element in play in the form of reading materials. Consider also a 1971 article from the same magazine, where Alberta Vocational Centre supervisor S. G. Souch raised a number of issues concerning the obsolescence of old occupational categories, the gap between education and work, and the importance of occupational psychology in the training of counsellors.\(^{153}\) Such concerns, although stressing on the vocational aspect of counselling, cannot be dismissed as either reactionary or lacking in nuance. In fact, seeing how Livingstone’s powerful critique of human capital economics took place over twenty years later, Souch’s concerns almost seem ahead of their time.

A closer look at the professional Canadian guidance journal during this time can illuminate the landscape of counselling with some more detail. The periodical journal *Canadian Counsellor* started its first volume in 1967, concurrent with the beginnings of the Hall-Dennis

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era, and ran continuously through the entirety of the 1970s. Articles in the early years were often concerned with the role and self-conception of the counsellor within the school. Counsellors and other researchers debated about whether their job was too medicalized for the good of the students,\textsuperscript{154} whether younger children needed counselling at all,\textsuperscript{155} and even more interestingly, whether the Hall-Dennis report was good or bad for the children.\textsuperscript{156} Some voices in the magazine was eager to distance itself from a “game” of “capture and cure”, one that “implies that our clients are sick and that our job is to unsick them.”\textsuperscript{157} But other voices at the same time continued to adopt an implicit framework where the child’s performance was a question of traits.\textsuperscript{158} In addition, other articles still were outright technocratic in their tones, suggesting engineering-style schematics and flow-charts that are meant to streamline the vocational guidance process.\textsuperscript{159}

In defense of the professional counselling community of the 1960s, there is no obvious connection between seeing the child as a sick patient and seeing the child as a bag of traits. In fact, the first view might encourage direct manipulation of the children in the interest of curing them, whereas the second view might discourage such interventions in the interest of respecting what each child is fated to become. Given a concrete history of curriculum medicalization ever since the 1920s, one could understand how between medicalization and fatalism, repudiating the


\textsuperscript{159} Price, D. W. “A computerized educational and vocational counselling program.” \textit{The Canadian Counselor}, Vol. 5, no. 2 (1971): 115-123.; note especially the massive flowchart on page 117
former could have seemed the more intuitive choice at the time. That both views were rooted in an objectified view of the human body and that neither may be desirable are things easy for us to recognize in retrospect; but gaining such a perspective may have been difficult there and then.

When the credit system replaced the Robarts Plan in 1969, students suddenly found themselves with a gamut of newfound choices as to what courses to take. In the words of R. M. Stamp, “Course choices tended to be influenced by a mixture of post-secondary requirement, parental wishes, advice from guidance counsellor and teachers, and individual whim.”160 Under such a system, the counsellor became a potentially key figure who could prevent the suddenly-freer student from being wholly lost not only in the range of her or his choices, but also in the administrative jargon surrounding them and the potential lack of clarity in their career-related consequences. Where stolid regimens of streams and requirements have receded, the guidance system moved in to govern the children in a more individualized and elastic manner. With the individualized credit system, it became more costly to exert top-down, uniform power over students’ education and their behaviour. What the guidance system accomplished was to offer a kind of pastoral power in its place. This power reached out to each student individually, as any governing power must if it is to function in an individualized framework. Previously, the top-down structure made collective demands upon the students in the plural. Now increasingly so with the resurgence of progressivism, the pastoral structure made individual suggestions to the isolated student, who was served up wholly to the focal point of the system’s gaze. In 1970 R. C. Clark, the Minister of Education and Youth in Alberta, contributed an article to the Canadian Counsellor, in which he remarked explicitly that counsellors can and should play a major role in the identity formation of future urban populations, who would otherwise face “increasing

difficulties in defining our identity as individuals, because this process of definition grows out of meaningful inter-personal relationship which develop between adults and young people in today’s society.”

Thus, to the extent that the counsellor propagates progressive ideas, these ideas would take root inside the student before a more conservative environment can intervene. But to the extent that the counsellor propagates normative mainstream thoughts and assumptions, these normative ideas will be smoothly imbibed while coated with a personal touch. This gives the system unprecedented influence over each individual child in terms of structuring their likes, dislikes, and their view of themselves. Moreover, the counsellor’s engagement is the medium through which the system can know of each student in more granular detail; to the extent that these interactions were structured, logged, and continuous, the counsellor’s work served also as a form of measurement. Thus in addition to tying the knot between schooling and workplace, the guidance services erected a monitoring and recording system that could keep files on each individual student as they dropped in for support.

As for immediate effects of guidance on STEM subjects, there is one interesting article from 1974 in the *Ontario Mathematics Gazette* documenting the social science students’ perception of math. The report found that aspiring social scientists often believed that statistics and algebra were the only mathematics that they were ever going to use, and that this belief was sometimes handed to them by the guidance system they were in. This suggests that the guidance system, in its mission to connect students to jobs, inevitably end up telling students

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163 ibid, p176
which skills are useful for which jobs. Moreover, in light of how Ontario counsellors in the 1950s and 1960s were supplemented with human selection handbooks, the guidance infrastructure had the capability and perhaps even the duty of assigning affinities between certain students and certain skills. The sum of these factors is thus in line with the neo-Marxist claim that in advanced capitalist societies workers are essentially defined by their jobs.\textsuperscript{164}

In any case, while the guidance system was far from unproblematic, it cannot be said that it was undesirable either. On the one hand, its role in arranging the marriage between the school and the market was not wholly instrumentalist in light of the times. It would be wrong to speak of this new pastoral power in a presumptuously negative way, since it buffered students against a number of educational hazards, and provided constraints in a way that was intended to enable rather than limit the student’s self-determination. On the other hand, there were certainly aspects of the guidance system that sought to impose a regime of surveillance and regulation, and such aspects cannot be so easily glossed. Although guidance files could be construed as a kind of criminal-medical record, especially for those children stricken with an inability to be useful in this way or that, there were also professional voices who opposed such trends. All in all it would be most prudent to view the counselling discourse during those years as something diverse and complex, though nevertheless tinted by an overshadowing array of discernable social thoughts that often, though not always, propagated a mentality of human selection.

**Human capital and economic imperatives in the school**

In 1965, the annual review from the Economic Council of Canada went to great lengths to state the importance of reducing unemployment. The commission actually held the elimination of unemployment as a long term ideal goal, and maintained that it was realistically possible to drive this figure below 3% by 1970. But entangled in this progressive vision was a view of the human as a “resource”, and the reduction of unemployment was justified on the grounds that it put this resource to “much fuller use”. In this report, “output per employed person” was another important metric used to estimate how much work was done by a working person on average. Already in the 1960s, we can thus see a language of productivity applied to the labouring human.

On a theoretical note, we might already be able to anticipate a few problems. If “output” is the amount of work society get out of a person, the “input” might be seen as the amount of effort society spends on the person’s education and training. Furthermore, once these scientistic concepts of human input and human output are laid down, the conceptual stage is set for the idea of human efficiency, which equals the output divided by the input. In other words, the efficiency of a human body is highest when the body does as much work as possible while consuming as little training as necessary. Taken to the limit, a working body that has not been taught at all is infinitely efficient, and any profit derived thereby is free. Of course the Council’s general rhetoric was quite progressive and would likely not have intended to take things in this direction, but we can take an empirical look at what they actually said, and see just how slippery the slope really was. Consider the following reasoning on the opening page of a chapter titled “Sources of Economic Growth”:

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166 ibid, p34-35
Explicit in this emphasis is the view that long-term expansion of the potential output or productive capacity of the economy may be traced ultimately to two main sources: first, an increase in the quantity of productive resources which can be put to use in the economy; and second, an increase in the productivity of those resources stemming from improvements in their quality and in the efficiency of their use.\textsuperscript{167}

The progressive qualifier in this line of reasoning rests on the fact that the only legitimate way to obtain efficiency from human resources is to improve their quality. This to say, efficiency is to be obtained by educating humans, and not by neglecting to do so. However, “improving quality” is geared toward increasing productivity. If education is justified on this basis of increasing productivity, then schools would have to teach whatever that was the most productive. Likewise, to “improve the quantity” of productive people, schools would have to increase the number of people schooled in whatever subjects that were deemed the most productive.

After saying how productivity is important, the next question becomes just what productivity really means, or how exactly it is brought about. The Council admitted that, at the time, no public consensus over such questions existed, but was seeking to create models and tools that will nudge the public towards coming to one:

In these circumstances, it would appear useful for the Council to attempt to clarify, to the extent that it is possible, the relative importance of some of these basic factors, and to facilitate the evolution of a public consensus about what is important – as well as what is not important, as regards productivity growth. …To the extent that such clarification is possible, and such a consensus can be evolved, this will help to fulfill the Council’s central responsibility, under its terms of reference as an advisory body, for indicating the public and private decisions and policies which would contribute most effectively to the

\textsuperscript{167} Economic Council of Canada. \textit{Towards Sustained and Balanced Economic Growth}. 1965, p45, original emphasis in italics instead of bold.
maintenance of a “high and consistent rate of economic growth” and to encouraging “advances in efficiency of production in all sectors of the economy.”  

As a demonstrative exercise in trying to pin down the factors affecting productivity, the Council proceeded to examine the productivity difference between Canada and the United States. The question was why the US had consistently higher real income (i.e. the effective level of wages after taking into account the country’s social context) per capita. The Council’s answer was twofold. First, Canadian industrial manufacturers were not being technologically efficient. In Canadian manufacturing routines, not enough repetitive tasks were being assigned per machine, which generally led to a need to invest relatively more in machines to do the same job. Secondly, senior management in Canadian industries tended to be less educated. The Council reported that when comparing Canada and the US, the education disparity in management was much more severe than the education disparity in common workers. Here we see a burgeoning motive to use education to train future elites, as well as a desire to increase mechanical productivity in the economy. The council concluded that the US had an edge because they poured a larger portion of their resources on developing the labour force as opposed to “capital investments” (e.g. machines, physical infrastructure, and social infrastructure). Here we see a general thrust of the Council: invest in humans to increase productivity. The economists at the time really seemed to believe it was possible to improve public life by improving the efficiency of private interests. Some of their arguments proceed with the explicit assumption that a person’s income reflects their productivity.

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169 ibid, p62

170 See ibid, p62 as an example
The Council’s review also dedicated a whole section on education. The Council adopted an instrumental attitude towards education, and cited a “vital need for creating and maintaining an adequate supply of professional, technical, managerial and other highly skilled manpower” for the future economy.\textsuperscript{171} Much emphasis was placed on bettering the “educational stock” of the country.\textsuperscript{172} Interestingly, the Council favoured the educational imperatives between the 1890s and the 1920s, disparaged the changes in the 1930s, and favoured once more the developments from the 1940s to the 1950s.\textsuperscript{173}

In this sense, they basically favoured every conservative era in terms of education, even as they advanced a rhetoric aimed at lowering unemployment. This was essentially a discourse of human capital that framed humans as things to invest in, in particular as an alternative to investing in physical and social infrastructure. Their ultimate recommendations included a reduction in high school dropout rates, and rapid development of universities into channels for “highly skilled manpower”.\textsuperscript{174} Education then, at the high school level and beyond, was to become a device used to deposit highly refined human resources into the labour market.

\textsuperscript{171} ibid, p71
\textsuperscript{172} ibid, p78
\textsuperscript{173} ibid, p75-76
\textsuperscript{174} ibid, p94
Section 4: Analysis of the interplay between progressivism and STEM subjects

The progressives’ participation in their own marginalization

Throughout the years, there were some recurring curriculum policies that conservatives and progressives championed fairly consistently. On the conservative side, there was a consistent preoccupation with the basic skills of reading, writing, and arithmetic, collectively known as the “three Rs”. They also had the habit of re-inscribing the separation and hierarchy between academic and applied streams, often in a rather public and dramatic manner. They also liked to stress the importance of content knowledge over pedagogy. On the progressive side, the 1870s era was already groping towards some conception of a child-centred education. The idea was to indoctrinate the young into becoming good subjects of the British Empire, but nevertheless there was some concern against harsh corporal punishments and rote learning. The progressive stint in the 1930s also paid homage to a child-centred curriculum.

Additionally, there was a new idea that was not present before, which was a “grouping together of like subjects”. That is to say, subjects generally seen as belonging to the same broad vein of inquiry should be somehow presented together in an integrated manner. Child-centred pedagogies again surfaced in the late 1960s, and the new credit-based curriculum “grouped together” the subjects into four broad bundles including science, social studies, art, and communication.

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175 Sutherland has a very in-depth treatment that demonstrates the early connection between pedagogical progressivism and religiously-inspired child advocacy movements in the first few decades after confederation. See Sutherland, Neil. *Children in English Canadian Society: framing the twentieth-century consensus*. Wilfrid Laurier University Press, 2000.
Overall then, the conservative has been pro-literacy, pro-content, and pro-streaming. The progressive has been pro-child, and pro-integration, albeit in a limited way. The progressive camp as a whole, due to their emphasis on the child as opposed to the content, never took a dedicated side on the relative merits of different disciplines, nor on the way in which they should be organized. Nor did they consistently take issue with academic/applied streaming. Consider the list of progressive curricular improvements in the 1937 curriculum, as outlined by the 1936 Ministry Report:176

[1] Greater attention to the English subjects
[2] Less number work in the primary grade and a more practical course in arithmetic throughout the grades
[3] Greater emphasis on health teaching
[4] Closer correlation as among civics, history, and other social studies
[5] More suitable complementary courses for those who will leave school at the end of grade IX or grade X
[6] More detailed outlined of the work to be covered in each subject or group of subjects in each grade
[7] A grouping together of like subjects

Taking a look at the 1937 reforms, the progressives seemed to be pro-literacy, pro-practical, pro-hygiene, pro-nationalism, pro-normalization of high school turnover, pro-clarity in expectations, and pro-integration. Here, the child-centred thrust of the curriculum was not explicitly stated. Simply reading through these doctrines without knowing that there was a liberal government in Ontario at the time, it could have been difficult to guess whether conservatives or

progressives were in charge. For the most part, it seems that, as long as the school revolved around its students in its rhetoric, everything was good enough for the progressives. To be sure, that itself is no small goal, but taking what is at best a pragmatic stance on almost everything else is a doctrine that might give us some pause.

Furthermore, medical elements of the 1930s and the post-medical elements of the 1960s in educational thought should alert us to a moral ambiguity in these “child-centred pedagogies”. The child may be the centre, but the centre of what? A mechanism that objectified the child, and delivered it to a regime of measurement and evaluation, is also quite “centred” on the object of its study. Moreover, giftedness can be seen as a creative way for conservatives to circumvent the child-content dichotomy. If the system ever manages to enforce a framework where the child is supposed to have some kind of visceral affinity for a particular set of content, then the dichotomy between child and content cannot be sustained, and progressive pedagogies will suddenly offer no distinctive platform. Adding to the factors of medicalization and giftedness is the enhanced role of “choice” in a progressively-charged curriculum. A math educator remarked in the *Gazette* in 1969, not entirely without nostalgia, that in the modern day it has become acceptable to question why a particular subject must be learned, and that dismissing the question can no longer constitute a serious reply.177 Such developments, as previously noted, were connected in no small degree to the McCarthy reforms in 1969, inspired by the Hall-Dennis Report in turn, which ushered in a new credit system made of electives. But, at the same time when the choices in the system were expanding, the identities that inform those choices became subject to increasingly

sophisticated forms of discipline. Thus the synergy between a choice-based credit system and an identity-forming counselling infrastructure cannot be stressed enough.¹⁷⁸

Some summary critiques can be made about the interpretative frameworks deployed by the pedagogical progressives. The pedagogical progressives have so successfully popularized the content-child dichotomy that both their sympathizers and their detractors often engage politically by accepting the dichotomy and taking a side. Indeed, it is already no small feat that the progressive side of an argument has won the discursive power to frame the terms of the debate. But what the progressives could not be expected to foresee was how in the Ontario context of the 1960s, “content” was what held many educator forums together within the educational field. The diverse range of opinions held by various math educators at the time was held together precisely by the very thing that progressive rhetoric opposed. When curriculum control was being ceded to content experts under the Robarts administration, educator forums and other expert cultures were precisely organized around content, which was the perceived antithesis of child-centred pedagogies.

Thus the unhappy fate of the progressive surge in the late 1960s was that its child-centred platforms were poised to offend too many expert cultures at once since they were all organized on the basis of content. Even as curricular control was ceded away from the government, an inherent level of institutional resistance emerged to dampen the progressive effects of the Hall-Dennis era.

¹⁷⁸ See Foucault, *Discipline and Punish*, 1995, p293-308. Foucault introduces a theoretical framework of what he calls the “carceral system”, wherein caretaking infrastructures are liable to become, in effect if not in intention, disciplinary cogs that channel and regulate the subnormal bodies within a modern social system. Suppose we let the “norm” represent “industrially teachable”, let the “infrastructure” represent “guidance”, and let the “carceral system” represent “a society that requires science-permeable bodies for commerce and war”, and evaluate the implications, the results are unfortunate.
Mathematics and the entrenchment of an insular culture of subject-specific education

Throughout the 1960s when the politics of education in Ontario was being rewritten on a broad level, a very different interpretative framework existing in the culture of math education buffered the field from the spirit of the times. Even when the Hall-Dennis report was announced, the terms of debate within the culture of math education did not change in response. Instead, they focused on the same set of debates that they have had for quite some time, such as the relative merits of the abstract versus the concrete, math for all versus teaching the gifted, procedure versus discovery, and last but not least content versus children. The same arguments existed in the early 1960s, and were carried well into the 1970s.

It cannot be concluded, though, that mathematics and related subjects featured corresponding educators who were wholly insulated against social and political concerns. W. W. Sawyer’s 1974 article in the Gazette¹⁷⁹ is a good example. In a critique of the changes in math teaching, Sawyer explained that “new mathematics” was a trend that emerged during the late 1940s in the United States when university professors in undergraduate math found their new students unprepared for the more abstract aspects of mathematics. When the space race began in 1957 and the need for increased math and science was recognized, this single-issue group was at the time the only established lobby for curricular reform, and thus the topics they wanted became the new curriculum, and it quickly became popular in North America. In Sawyer’s words, the advocates of new math had little experience in making content “intelligible” to either the high school teachers or their students, and thus the new math became accessible to only a few students

who could get extra support from their families and remain interested.\textsuperscript{180} Sawyer also included positive pedagogical examples in grade school mathematics, never once suggesting that pedagogy and content are “opposing” interests that had to be “balanced.”

That is not to say however that he had an infallible stance. Those wary of gendered remarks may take issue with his claim that “premature abstraction emasculates the mind.”\textsuperscript{181} Others might remark that in the present world, concrete math creates mere clerks who perform jobs that are easily automated.\textsuperscript{182} All in all Sawyer’s view is far from infallible, but at least he does pay some attention to social circumstances surrounding math and does not drive wedges between pedagogy and content. Moreover, his explanations give an important account of how social intelligibility and outreach was not part of the intended agenda for the new curriculum makers. In addition, a stream in which only a few can pass exacerbates the steering power of human selection discourse in the guidance and counselling infrastructure; Sawyer’s article is significant in that it gestures towards the constructed nature of seemingly natural interest or lack of interest in a subject. Interest in the content in this case can be produced in the family unit if they have the knowledge capital and the time to offer sustained support or pressure.

As an important aside however, sexist and problematic statements show up in other places on the \textit{Gazette} as well and this may illustrate something significant. G. G. Steel remarked in 1967 that that increasingly abstract math signifies an increasingly abstract society, where “prospective husbands will have to find the abstraction of a wife”, and that this would not be

\textsuperscript{180} ibid, p106-107
\textsuperscript{181} ibid, p106.
\textsuperscript{182} See for example, Conrad Wolfram’s 2010 TED talk about teaching math with computers and reducing the role of calculation. I do not necessarily endorse his position but it is very much in line with the present day direction of STEM education. \url{http://www.youtube.com/watch?v=60OVlfAUPJg}
“satisfying.” If we recall Kohlstedt’s study and the gendered nature of the content-pedagogy divide, we see that gender issues remain grossly un-thought in the discourse of the 1960s and that the same discourse also exhibits at times the content-pedagogy divide. To pursue this line of thought however would require a dedicated study, which I cannot initiate here.

Progressivism’s encounter with social history education: what was different?

It is a fair question at this point to ask, what about the other discipline groups? Are their teaching organizations not also organized along content lines? Did they, then, exhibit the same resistance to pedagogical progressivism? One answer to this question can be illustrated if we look at the progression of social history subjects.

Much of the debate heading into the 1960s in the social history subjects is whether or not to merge history and geography into social studies. In the Bulletin, which was the official publication from the Ontario Secondary School Teachers’ Federation, heated debates often cropped up about this issue. The move by the Deputy Minister of Education in 1969 to bundle the subjects together into four broad groups was essentially a victory for the “yes” side. In other words, the reforms spurred by the Hall-Dennis report did in fact answer one of the most

184 Kohlstedt, Teaching Children Science, 2010. p171
185 Ken Osborne gives detailed accounts of what perhaps can be called the “history of History” in Canadian schools. His work about history provides a good reminder that the sciences were by far not the only subject that was used for social engineering. Indeed, the nationalistic goals of the state had a very direct vested interest in the teaching of history. See Osborne, Ken. “Teaching History in Schools: a Canadian Debate.” Journal of Curriculum Studies, Vol 35, no 5 (2003): 585-626; Osborne, Ken. “Our history syllabus has us gasping’: History in Canadian Schools -- past, present and future” Canadian Historical Review, Vol. 81 (2000): 404-435.
186 See Snell, B. E. “With Malice Towards None – I Choose the Social Studies,” The Bulletin for Ontario Secondary School Teachers’ Federation, vol. 37 no. 2 (1957): 69-70, 120-123; Snell was defending Social Studies, which was actually response to an earlier article defending separation.
explosive topics in the teacher community. Moreover, the social studies stream was in fact created by the new policies. Therefore, no content-based “common ground” amongst social history teachers existed during the Hall-Dennis era.

Thus, social studies was different from math in two crucial ways in terms of their response to the political pendulum of the 1960s. First, the Hall-Dennis reforms featured policies that provided answers to questions that the discipline actually cared about. Secondly, although the progressive rhetoric of children-over-content attracted the ire of historians, there seemed to be much more disturbance over just what the content was. Osborne notes that, starting in the 1960s, left-leaning social history began to assert itself against the right-leaning national history with increasing vigor, to the point where both sides often thought the other incompatible.\(^{187}\) The situation between math and history cannot be placed on the same grid because the socialist-nationalist divide within the expert historical culture has no mathematical analogue. One could argue whether linear algebra, set theory, and proofs were appropriate for a given age group. But no one within the expert culture could seriously argue that linear algebra was deleterious to the discipline at the professional level, or that set theory was somehow not real math, or that proofs excluded calculus. Between math and history, such a level of contention seems unique to history. For worse or better this would have made it harder to erect substantive resistance to curriculum change.\(^{188}\)

**Notable external associations during 1950-1970**


\(^{188}\) To this Osborne might have added the challenge of “being forced to provide structure” as an additional factor. When the theories of Jerome Bruner became popular in the 1960s, the perceived legitimacy of history suffered because Bruner assumed every discipline had a cumulative and essential knowledge structure. The sciences could conform to this grid, but history was one of the subjects that failed to. See Osborne, ibid. See also Tomkins, *A Common Countenance*, 2008, p267.
In light of the apparent significance of a subject-based consensus in teacher organizations, it is worthwhile to look at the state of the expert cultures behind each broad disciplinary area during this time. Since it is often these expert cultures that drive content-based curricular reform in their own domains\textsuperscript{189} as well as provide guiding literature for such causes, the cohesion of the expert culture can affect the degree to which the corresponding discipline can buffer itself against social and political concerns. Fleming’s multi-volume study of Ontario’s education system in 1971 provides some detailed information on external educational associations in the history of Ontario. Some notable organizations of this nature are worth a brief mention.

[1] The Canadian Association of Physicists was founded in 1945, and incorporated in 1951. It was geared towards increasing the presence of physics in every part of society, including education, although it did not dedicate an internal group to education until much later. From 1958 forward, the association has been receiving corporate and industrial donations. By 1968, it had 5 subject-based divisions but the educational division has still not yet been conceived.\textsuperscript{190} This account matches well with my own empirical findings. The Canadian Journal of Physics split off from the Canadian Journal of Research precisely in 1951. Of the roughly 170 articles and notes in the 1959 volume, 14 articles directly acknowledged the Defense Research Board of Canada as either a funder or a supplier, along with a number of other articles funded by oil companies, mining companies, electric companies, as well as the Atomic Energy of Canada, Ltd., which too was a limited corporate body. Overall within the years of 1957-1961, editorial references to anything remotely qualitative, let alone education, were nowhere to be seen.

was a time when mathematicians and engineers in Ontario were well ahead of their counterparts in physics in engaging education. But despite its disengagement from education, science at the time was far from politically neutral; it had already been deeply enmeshed in the military-industrial complex.

[2] The Science Teachers’ Association of Ontario was formed in 1890. Science itself has actually been a permitted subject since the 1850s, but since there were often no teachers who could teach it, the subject languished for a long time. From the onset, the association tried to address a whole range of issues including lack of teachers, rote learning, bad content, bad exams, and administrators who were skeptical of science. During 1910-1940, science teachers met mostly to acquire ideas handed down from professors, and it was not until the 1950s that high school teachers were beginning to have some voice in the organization.191

[3] The Canadian Political Science Association was formed in 1913, went into hiatus soon after because WWI was a sensitive period, and revived eventually in 1929. Its original vision included inquiries over economic, social, and political concerns in Canada. Eventually, sociology and anthropology would split off in 1966, and economics would split off in 1967. This decade saw some tectonic shifts in the social historian culture in the Canadian context, and the Canadian Journal of History and Social Science emerged with its first issue in 1965.192 It also points at a possible reason why there seemed to be less content-based buffering of progressive agendas in their corresponding subjects in the public school. Compared to their counterparts in

191 ibid, p143-144
192 ibid, p247-249
the scientific culture, the social historian culture lacked a stably demarcated expert organization from which to launch curricular demands.

**Progressivism and counselling in the 1960s**

A counterintuitive feature of the Hall-Dennis report was that, while it called attention to the student’s need for socialization, some of its policy recommendations produced deskilling effects on the school counsellor. In 1969, R. C. Harris, a guidance coordinator from Scarborough, cautioned in the *Canadian Counsellor* that a scheme where “every teacher is a counsellor” may not be desirable. By outsourcing counselling duty to “homeroom” teachers, the Hall-Dennis report elided the importance of having dedicated psychologists and social workers to address complex issues that children may be having.\(^{193}\)

There is much significance in this. It shows that, even within the pedagogically progressive forces, there are moments when it fails to fully commit to the socialization needs of the child. When it comes to struggling children, denying the importance of social workers and psychologists excludes *a priori* the possibility of a structural problem. When someone’s expertise deals precisely with structural problems in the social contexts that embed the child, denying the need for that expertise amounts to saying that structural problems do not exist. Very importantly, such ideas were promulgated by progressive forces at the time, showing us that insufficient attention to structural problems is not a trait limited to reactionary ideologies. Thus, just become some structural problem was ignored does not automatically entail there was a deliberate top-down conspiracy. There would have to be much more proof before such claims

can be made. In this case, seeing as how the official title of the Hall-Dennis report was *Living and Learning*, it seems evident that there was no direct intention to make problems of living invisible. It is also clear that the counselling field did contain professionals who were not just concerned with the children, but were also attentive to the possibility of structural problems embedding each child.
Section 5: Conclusions

In this thesis, I have described interrelated issues regarding the history of math, science, engineering, and technology (STEM) education in the Ontario context. What I have traced was a history of STEM thought from the founding of the public school system in the 1870s to the series of changes in the 1960s that gradually split the curriculum by its subjects. Moreover, I have shown how the questions of what science meant and how close its branches should work together were conditioned by social and political circumstances. Additionally, I have also tried to present the interrelations between the various forms of science and technology education on the one hand, with the administrative and pedagogical versions of progressivism on the other. In light of such a framework and the evidence gathered, a list of conclusions can be drawn.

[1] At the onset of the public school system, science was a marginal subject; and where it existed, it played the role of the “other” to a religiously charged discourse of humanities subjects and especially Latin. During this marginal period, educational debates conflated the humanities-sciences binary with two other binaries: the literacy-vocational binary and the mental-physical binary. Under such a system, math actually had an ambiguous status that placed it at a distance from the natural sciences, on account of it being a “literacy.” In spite of the early ideological confusions surrounding the place of science in the school, divisions between science, technology, engineering, and math could not be sustained in the face of military and economic realities in a modernizing society. Military and economic applications of science demanded that those four branches be taught increasingly in tandem. Originally, when the public system was in its infancy,
vocational education was often associated with poor, working-class imageries in educational debates, and the classics-science divide was sometimes conflated with the docile-unruly divide. As the applications of STEM subjects made these subjects more prestigious, and as their certifications led to more white-collar social positions, these subjects began to cut their ties with blue-collar images. Home economics and agriculture at this time declined in relative prominence in the technology field, and a unified national research journal that once equated technology with food science was reorganized into different journals in the early 1950s.

[2] For the administrative progressives, scientific thought impacted the educational system as a whole. The curriculum became increasingly medicalized in the 1920s and 1930s. When a medicalized view of the child was coupled with a longstanding tradition of exams, this combined into a discourse of human selection and laid the groundwork for the guidance infrastructure that emerged over the next few decades. Meanwhile, on the side of pedagogical progressives, the science-vocational-physical tripartite intersected heavily with the work of early proponents of pedagogical progressivism near the turn of the 20th century. Not only did this three-part cause make it possible for the body of the child to matter more than the content being poured into it, the vocational slant was perceived as a form of getting in touch with the real world. Even on the administrative side, higher education institutions acted in line with this by stepping away from denominational organization and looked instead to business and military sponsors, often with scientific research as a marketable leverage. Such trends actually represented a step away from tradition at the time. As pedagogical progressives gained a voice in educational decision making in the 1930s, the child-content dichotomy became widely used and made their way into governing documents. This made their outlook difficult to share in curriculum debates with educator groups that were institutionally organized by subjects. Thus,
institutionally organizing educator groups by subject has had in the past an inherently dampening effect on the dissemination of pedagogically progressive frameworks.

[3] Subject based curriculum reforms in math during the 1960s in Ontario served as a kernel for the subject based splitting of the overall provincial curriculum. During this time, the Ontario math educator community was reeling from the introduction of abstract mathematics in public schools, and often interpreted other changes in educational politics in terms of this main concern. Although a former president of the Ontario Mathematics Commission was a strong advocate of a two-tiered mathematical education in high school that differentiated the gifted from the masses, a great many educators were implicitly committed to an agenda of “mathematics for all.” Although these educators were somewhat impermeable to the progressive rhetoric of the Hall-Dennis report, they were by no means wholly reactionary. There were subtle signs of contradictions within their forums, though published articles had as their common ground a strong dedication to subject matter. Importantly, there was no evidence that any significant portion of the math educators had strong beliefs in dividing students based on their apparent abilities. The vocational guidance system actually did more in this regard, and indeed some math teachers did not look upon their role kindly.

[4] The guidance infrastructure became sizable in the 1960s, and brought with it a kind of pastoral power that was capable of keeping individuals on file despite large numbers of children inside the school system. Vocational counselling, while not the department’s only duty, was supplied with annual catalogues listing a vast array of human selection tests by the Ontario College of Education. These tests categorized people, and the basis of division for a number of these tests was mathematical and scientific aptitude. In fact, government officials in the early 1970s have even explicitly expected the expanding guidance system to play a role in the child’s
identity formation. Coupled with the increased prominence of choice-based electives under the new credit system at the time, refining the means of producing desired identities inside the child could indeed have had far-reaching effects. The 1950s and the 1960s then, illustrates a time period in which disciplinary efforts moved away from controlling course choices and towards shaping the identities that inform how course selections are made. It should be noted, however, that some professional counsellors at this time were in fact anxious to distance their field from an overly medicalized view of children, rejected the mandate to manipulate their clients, and called for an approach that addressed not only their cognitive and vocational needs but also their social needs. Moving forward from this point, the question for child-centred progressives on a philosophical level then is whether they can centre on the child without losing sight of what embeds the child. Indeed if the child is in a class full of content, then that content constitutes a part of the context, though never the whole or even the most of it.
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