Assessing

Ontario Curriculum

Science & Technology

Long Range Plans

Ronel M. Alvarez

Bachelor of Education

Primary/Junior Division

Tigist Amdemichael

Science & Technology in the Primary/Junior Divisions

Faculty of Education

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PART 1

Long-Range Plans

“A long-range plan outlines and organizes curriculum expectations. It is a living document that is revised as educators become increasingly aware of the abilities, strengths, needs, and interests of students. ”

(Ontario, 2022)

A long-range plan outlines possible sequences of instruction for the school year. There are many ways to structure an effective plan for learning. The plans can include clusters of learning that have areas of focus from science and technology, as well as examples of cross-curricular connections that can be made to some expectations in other subject areas.

A long-term plan details various instructional sequences for the academic year. There are numerous methods to craft a successful learning plan. These plans may incorporate learning clusters emphasizing science and technology, along with instances of interdisciplinary links to meet expectations in other subject areas.

The Long Range Plan Model

Click on the link to access the Long Range Plan Model for this study:

Long Range Plan Grade 6, Model 1

The model details out plans for each suggested month or timeline. Each suggested times corresponds to a focused Big Idea. Term 1 is focused on the impact of the topics on the environment, and Term 2 is focused on the understanding and application of technology in each topic.

Term 1: Science and Its Impact' on Our Environment

September, October - Biodiversity

October, November - Electricity

November, December - Space Exploration

December, January - Flying Machines

Term 2: Technology and Its Influences

February - Intro to Technology

March, April - Flight Machines

May - Climate Change

May, June - Space Exploration

Additionally, the model details out the following details to support the plan for each timeline/strand:

Overview, Guidelines, Best Practice and Assessment Ideas

Big Ideas and Guiding Questions for Inquiry Stance

STEM/Skills and Connections (Strand A)

Stands and Expectations

Cross-Curricular Integrations

Resources

More details about the Long Range Plan Model is found here.

PART 2

The Question Tool for Assessment

Consider the following reflective questions for consideration when developing, implementing, and reflecting on long-range plans:

1. *Does the long-range plan engages students in connecting and applying science, technology, engineering and mathematics concepts as they consider real-world issues related to our changing world including society, the economy, and the environment (ex. climate change, emerging technologies)?*
2. *Does the long-range plan provides students with opportunities to invent as they design and build innovative solutions to problems that can be solved by science and technology through the engineering design process and includes hands-on, experiential learning opportunities to support classroom activities that nurture and spark curiosity and wonder via scientific experimentation and research?*
3. *Does the long-range plan addresses First Nations, Métis, and Inuit knowledges, practices and perspectives in relation to science and technology while showcasing the important contributions made to science and technology by people with diverse lived experiences and from various communities*

4. *Does the long-range plan ensures that all students see themselves as confident, effective science and technology learners and practitioners by incorporating student voice, choice, and lived experiences to support engagement and understanding while honouring and valuing varied realities of students and communities through using diverse resources, examples, and pedagogical approaches?*
5. *Does the long-range plan incorporates tasks that are respectful and reflective of high expectations for all students supported by assessment that is varied to include conversations, observations, and products?*

PART 3

The Analysis and Recommendation

The following table contains the assessment of the long range plan model. Analysis consists of evidence criteria (see *Part 2)* being assessed as *no*, *inadequate*, *adequate*, or *extensive* evidence in the analysis and evidences from the Long Range Plan Model (see *Part 1).* Rationale consists of references supporting the analysis. Recommendations consists of considerations with references. All references are listed in *Part 4.*

Criteria	Analysis	Rationale	Recommendations
Does the long-range plan engages students in connecting and applying science, technology, engineering and mathematics concepts as they consider real-world issues related to our changing world including society, the economy, and the environment (ex. climate change, emerging technologies)?	**Adequate:** Term 1 (Table 1) is focused on fundamentals of science and their impact on the environment, including of climate change. (e.g., Biodiversity/Electricity/Space exploration/Flying machines and its impact on our environment) Cross-Curricular Integrations (Column 5) provides avenue for consideration of economic and social aspects to science and technology (e.g., Social Studies) With such, Big Ideas and Guiding Questions for an Inquiry Stance is filled with engagements (Columns 1 & 2) connecting STEM into real-world issues (e.g., Big Ideas, Guiding Questions, Stand A connections)	Program Planning and Cross-Curricular and Integrated Learning The Impact of Coding and of Emerging Technologies Teachers and students may want to investigate emerging technologies, such as artificial intelligence and automation, that impact a wide range of areas and disciplines. They may also want to explore emerging technologies in specific areas, such as agriculture, horticulture, health care, or biology, in the Life Systems strand, or in electrical and communication systems, transportation, and chemistry, in the Matter and Energy strand. Skilled Trades Educators are encouraged to help students make these important connections, as they provide students with authentic, meaningful, and hands-on experiences and activities that connect directly to their lives and communities Climate Change Students will develop the skills and knowledge needed to understand the causes and potential innovative solutions and mitigation strategies related to climate change and other environmental issues, and how they can make the most environmentally responsible decisions possible, given the choices they have. (Ontario Curriculum Science & Technology, 2022, pp. 79-85)	Approaches to Content Integration There are a number of different approaches to the integration of content (Moore, Johnston, and Glancy, 2020). Terms like interdisciplinary and integrated are often used interchangeably to describe approaches that connect learning across content domains (Czerniak et al., 1999; National Research Council [NRC], 2014b). Based on a review of the literature (e.g., Couso, 2020; Czerniak et al., 1999; English, 2016; Moore et al., 2020; NRC, 2014b; Rennie, Wallace, and Venville, 2012; Sarama et al., 2017), the committee proposes four main approaches that have typically characterized efforts to connect content domains: 1. Superficial Connections (Add-On or Sequential)—activities that showcase another discipline is added into a unit with little connection other than the topic. 2. Partial Integration—Two or more domains are addressed simultaneously, sometimes with one playing a supportive role. 3. Full Integration—All major domains are combined in every major lesson, instructional activity, or project. An overarching, usually real-world problem situates the use of multiple domains, but do- mains may not be fully supported. 4. Interdisciplinary Integration—Domains are connected sometimes via partial and other times full integration, with the criterion that each retains their core conceptual and epistemological structures so that connections serve the goals of each discipline. (Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Educators, 2022, pp. 131) Strategies for Integrated Learning 1. Engage children in investigation and design experiences that draw on multiple domains. When instruction situates children's science and engineering learning in meaningful and rich contexts, children engage in activity that recruits—and potentially deepens—prac- tices, skills, and knowledge developed in other parts of the school day and may build positive identities in science and engineering (e.g., English, 2016; McClure et al., 2017; Moore, Johnston, and Glancy, 2020; NRC, 2014b). 2. Make integration explicit in designs and teaching. Even in mean- ingful contexts that call for activity that transcends disciplines, integration may not automatically

			support productive learning experiences (NRC, 2014b). Therefore, designs need to consider the potential learning and identity development within the mul- tiple domains, and make relationships across domains explicit for children. 3. Support children's knowledge in individual disciplines. Domains often need to be learned in and of themselves, with dedicated time for each subject and a basis in a learning trajectory for children's development of central understanding and practices (Clements and Sarama, 2021b; English, 2016). For example, teaching science within the context of literacy can be reduced to "content-rich literacy," where the target literacy knowledge and practices drive the work, and children do not learn meaningful science content or develop an understanding of science and engi- neering practice. 4. More integration is not necessarily better. Research comparing various types of integrated curricula does not always support full integration (NRC, 2014b). Focusing on opportunities to use the disciplines in mutually supportive ways can help to ensure that children are learning and developing practices in each. (Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Educators, 2022, pp. 131-133)
Does the long-range plan provides students with opportunities to invent as they design and build innovative solutions to problems that can be solved by science and technology through the engineering design process and includes hands-on, experiential learning opportunities to support classroom activities that nurture and spark curiosity and wonder via scientific experimentation and research?	**Adequate:** Term 2 (Table 2) is highly focused on the application of scientific processes into solutions they STEM. BIG Ideas and Guiding Questions (Column 1) both allows integration of scientific and technological knowledge thru curiosity and wondering such as questions that leads to scientific and engineering processes. Activities in STEM Skills and Connections (Column 3) reflect the Big Ideas and Guiding Questions that demonstrate hands-on activity relating to Strand A.	Curiosity and Wonder in Science & Technology The curriculum also strives to inspire students with a spirit of inventing, designing, making, and entrepreneurship as they use their knowledge from the classroom to develop innovative, made-in-Canada solutions to global issues. Within the science and technology classroom, students' curiosity may be expressed explicitly, with direct questions, such as "How does that work?", or expressed subtly as they consider the results of an experiment or the results of testing an engineered design. They may bring questions into the classroom about scientific and technological phenomena they have observed in their own lives, or initial classroom investigations may lead them to extend their thinking and further compare and analyse concepts. Processes such as scientific research, scientific experimentation, and engineering design provide a framework within which to situate and nurture this curiosity. The Ontario curriculum provides opportunities for students to appreciate and wonder about scientific concepts and processes, as well as current and emerging technologies and innovations. (Ontario Curriculum Science & Technology, 2022, pp. 60-61)	Use of different modalities in forms of investigation including Field Study; Place-Based Work, First-Hand Observational Studies Over Time, Building, Tinkering, and Optimizing, First-Hand Comparisons and Experiments, Simulations, abs Second-Hand Data, with considerations with learning environment and instructional practices. Use of Participation Structures for Investigation and Design such as turn and talks, group talks, collective exploration, guided discussions, and open- ended discussion. Learning environments are enhanced when teachers use targeted peda- gogical strategies that invite children to make their thinking visible and encourage others to engage with those ideas; that is, teachers in these environments elicit and work with children's ideas. (Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Educators, 2022, pp. 119-120)

Does the long-range plan addresses First Nations, Métis, and Inuit knowledges, practices and perspectives in relation to science and technology while showcasing the important contributions made to science and technology by people with diverse lived experiences and from various communities	**Inadequate**: Strand A3 in Column 3 almost non-evident. Minimal evidence can be found, mostly on Cross-Curricular Integrated Learning (Column 5) relating to agriculture/social studies. Other diverse practices and perspectives relating to science & technology missing.	Stand A. STEM Skills and Connections A3. Applications, Connections, and Contributions: demonstrate an understanding of the practical applications of science and technology, and of contributions to science and technology from people with diverse lived experiences A3.1 describe practical applications of science and technology concepts in their home and community, and how these applications address real-world problems A3.2 investigate how science and technology can be used with other subject areas to address real-world problems A3.3 analyse contributions to science and technology from various communities (Ontario Curriculum Science & Technology, 2022, pp. 147-148) Learning opportunities and resources Schools are expected to give students and staff authentic and relevant opportunities to learn about diverse histories, cultures, and perspectives. Lessons, projects, and related resources should allow students to see themselves reflected in the curriculum (e.g., providing information about women's contributions to science and technology, about Black inventors, about Aboriginal beliefs and practices related to the environment; using texts written by gay/lesbian authors). Students need to feel engaged in and empowered by what they are learning, supported by the teachers and staff from whom they are learning, and welcomed in the environment in which they are learning. (Equity and Inclusive Education in Ontario Schools, 2024, p. 24)	Addition of Guiding Questions relating to Strand A3 convention and corresponding activities and engagement. Consider the following: Land-based learning initiatives across the country are revitalizing cultural practices by transferring Indigenous understandings, skills and philosophies to youth. These initiatives continue to grow and expand with increased demand and interest in land-based education. Individuals and families participating in these initiatives are becoming stewards of their environments as they build a sense of pride in history and culture and share their knowledge with others. Other examples of culturally relevant STEM activities used today include: Identifying how Indigenous art incorporates math and geometric patterns; Using engineering and design skills to build traditional structures; Exploring the science and mathematics of quill art boxes, including understanding how to analyze the structure: circle, circumference, space, and patterns; Utilizing engineering principles and prototypes focused on how Indigenous people developed tools; Teaching the intersection between medicine and engineering e.g., the processing of birch oil by boiling the bark in a wood basket; Observing a salmon tank to learn about the fish and how to raise them; and Learning about the engineering required to build a canoe or how a beaver builds a dam (Indigenous Land-Based STEM Education: Discussion Paper, 2021) *See more in the cell below.*
Does the long-range plan ensures that all students see themselves as confident, effective science and technology learners and practitioners by incorporating student voice, choice, and lived experiences to support engagement and understanding while honouring and valuing varied realities of students and communities through using diverse resources, examples, and	**Inadequate**: Strand A3 in Column 3 almost non-evident. Minimal evidence can be found, mostly on Cross-Curricular Integrated Learning (Column 5) relating to agriculture/social studies. Other diverse practices and perspectives relating to science & technology missing.	Implementing Principles of Inclusive Education Teachers can give students a variety of opportunities to learn about diversity and diverse perspectives. By drawing attention to the contributions and perspectives of historically marginalized groups, and by creating opportunities for their experiences to be affirmed and valued, teachers can enable students from a wide range of backgrounds to see themselves reflected in the curriculum. It is essential that learning activities and materials used to support the curriculum reflect the diversity of Ontario society. (Ontario Curriculum Science & Technology, 2022, pp. 18-19) Instructional practices Schools are expected to support effective instructional practices that reflect the diverse needs and pathways of all students. Currently, there are excellent examples of practices that consider the diverse needs of individual learners. Differentiated instruction takes into account the backgrounds and experiences of students in order to provide content that is relevant to them and approaches that are suited to their individual interests, aptitudes, and learning needs.	Emphasize increased achievement, representation, and identification with science and engineering. Teachers learn ways to increase representation of "who does science and engineering" to include a range of historically marginalized groups, across gender, learning disabilities and/or learning differences, and linguistic and cultural background. And also to connect science and engineering learning with children's interests and identities. Curricular materials include representations of scientists and engineers of color and children of color doing science and engineering. Encourage children to tie their cultural and linguistic backgrounds to science and engineering concepts. Seeing science and engineering as part of justice movements.

pedagogical approaches?		(Equity and Inclusive Education in Ontario Schools, 2024, p. 24)	Children learn about the connection between the natural world and human actions and decision making. Children investigate how Black, Indigenous, and other communities of color experience disproportionate effects of food deserts, natural hazards, and environmental pollution. Teachers recognize the connection between their own power and positionality, Western or Eurocentric science and engineering, and children's and families' engagement in science and engineering. Teachers learn about the connections among a science phenomenon or engineering design, local or global instances of the phenomenon or design, and implications for communities. Curricular materials invite children to ask and answer their own questions about community-relevant issues and make decisions for ethical futures. And also to invite children, families, and teachers to examine issues from historicized lenses, and understand how contemporary scientific practices or concepts may have deep roots in racist or other oppressive histories. (Science and Engineering in Preschool Through Elementary Grades: The Brilliance of Children and the Strengths of Educators, 2022, pp. 26-27)
Does the long-range plan incorporates tasks that are respectful and reflective of high expectations for all students supported by assessment that is varied to include conversations, observations, and products?	**Adequate**: Although there are various aspects in the model that suggests task that are respectful and reflective of high expectations for ask students, the model failed to explicitly highlight the importance of classroom conversations in STEM learning. Observational and product assessment are highlighted enough thru provided activities in Columns 3, 5, and 6.	Teachers use a variety of assessment strategies to elicit information about student learning. These strategies should be triangulated to include observation, student-teacher conversations, and student products. Teachers can gather information about learning by: designing tasks that provide students with a variety of ways to demonstrate their learning; observing students as they perform tasks; posing questions to help students make their thinking explicit; engineering classroom and small-group conversations that encourage students to articulate what they are thinking and further develop their thinking. (Growing Success, 2010, p. 34) Commitment to professional learning within school and board communities, discussed later in this chapter, develops the collective capacity of staff to work together to achieve the fundamental purpose of the education system – that is, high levels of learning for all students. Every student's learning experience can be improved when there is a shared commitment to high expectations for every student and when educators are engaged in a collaborative problem-solving process that is focused on student learning. Assessment for learning is integral to this process. Ongoing professional learning is driven by educators to create knowledge and opportunities that support these practices. (Learning for All, 2013, p. 53)	Strategy 1: The importance of conversations Inquiry-based learning is an approach to teaching and learning that places students' questions, ideas and observations at the centre of the learning experience. Educators play an active role throughout the process by establishing a culture where ideas are respectfully challenged, tested, redefined and viewed as improvable, moving children from a position of wondering to a position of enacted understanding and further questioning (Scardamalia, 2002). Underlying this approach is the idea that both educators and students share responsibility for learning. To create a culture of this sort, students need to be made aware of the different kinds of contributions that can be brought to the group. For example, proposing theories, building on a theory or idea, choosing to agree or disagree with a statement, synthesizing individual ideas and class-wide themes and making connections to related experiences in the wider world are all examples of the various kinds of student contributions that can be made. Keep a record of students' questions, especially the types of

			questions that occur naturally and frequently among the students you teach. These questions often offer “inquiry potential” and can be held onto and introduced when the time is right. Alternatively, the questions can be posted in the classroom (on brightly coloured paper, written by the students themselves) for the community of learners to refer to throughout their investigations. (Capacity Building Series SSE 32, 2013)

Part 4

References

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