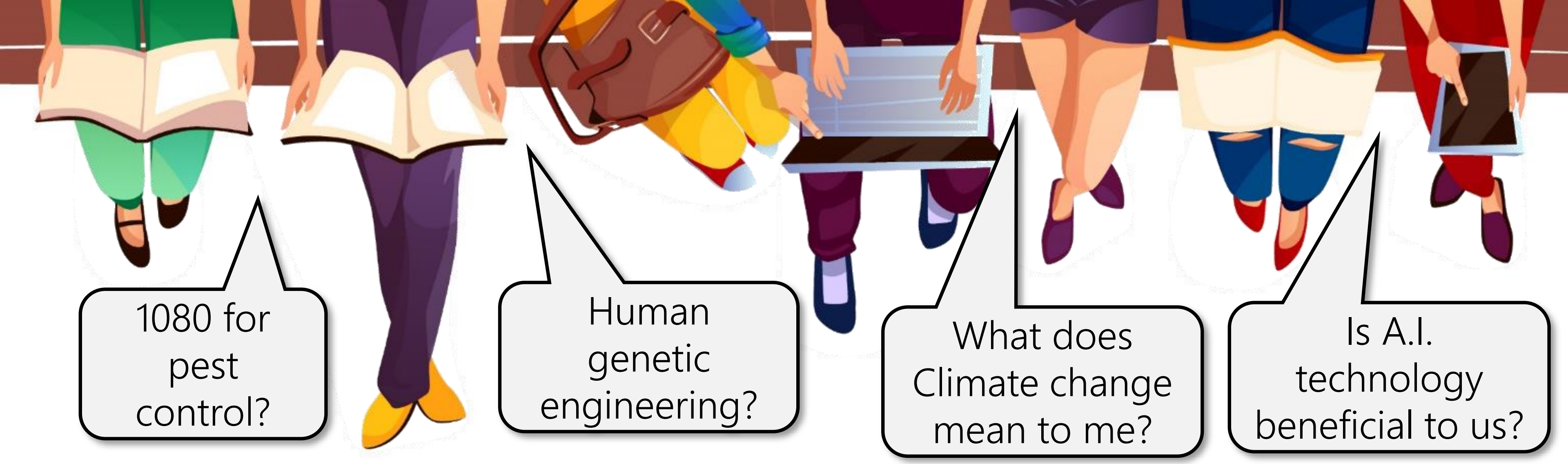
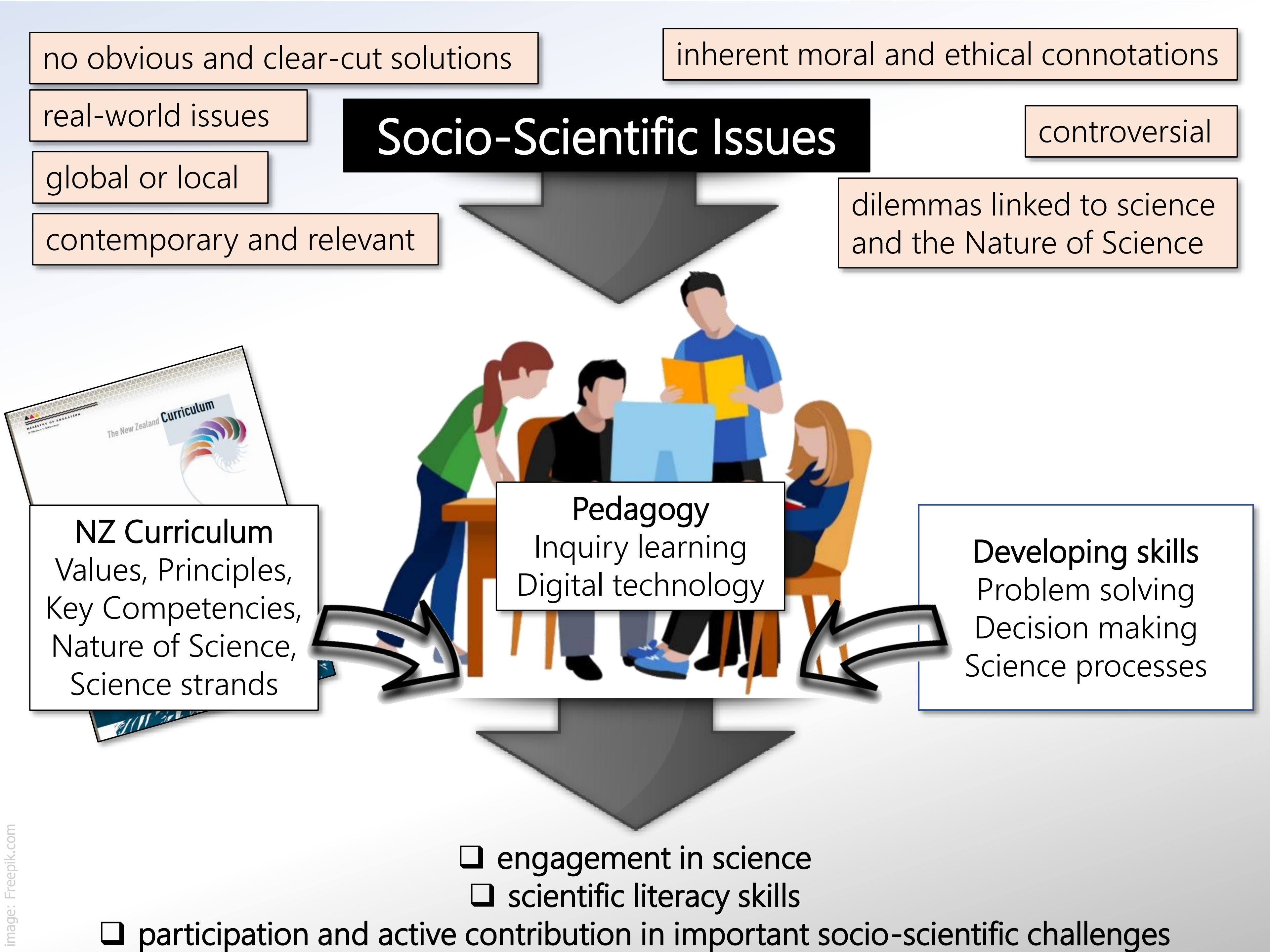
image: Freepik.com

Full referenced notes under each slide

# Making the case for teaching Socio-Scientific Issues in Junior Secondary Science




As science educators, we must ensure learners are prepared to engage with, and navigate through, numerous contentious, open-ended, and complex socio-scientific issues, both local and global, confronting them as participating citizens.
Gluckman (2013)


Socio-Scientific Issues
no obvious and clear-cut solutions
real-world issues
global or local
contemporary and relevant
inherent moral and ethical connotations
controversial
dilemmas linked to science and the Nature of Science
The New Zealand Curriculum
NZ Curriculum
Values, Principles, Key Competencies, Nature of Science, Science strands
Pedagogy
Inquiry learning
Digital technology
Developing skills
Problem solving
Decision making
Science processes
❑ engagement in science
❑ scientific literacy skills
❑ participation and active contribution in important socio-scientific challenges
image: Freepik.com

# Exploring Socio-Scientific Issues as a pedagogical approach

**MOTIVATION**
Contexts that are engaging, and relevant real-world experiences

**SETTING**
Cross-curricular Junior science inquiry-based learning class


**CONTEXT**
climate change

**GOALS**
Developing scientific literacy

Transfer skills and make relevant connections between what they are taught and what they experience in their own lives

**MY POSITION**
Investigate the benefits of SSI, and discussing possible issues, to promote this pedagogical approach as being valid and worthy for inclusion in our future mainstream junior science programmes, using literature review and reflections from my own teaching practice

SSI has become a significant pedagogical means to approaching science education, and developing scientific literacy in our learners

# Scientific Literacy

Scientific Literacy combines questioning, making evidence-based conclusions, and knowledge about science "in order to understand and help make decisions about the natural world and the changes made to it through human activity." (OECD, 2003)

"identify scientific issues; explain phenomena scientifically; and use scientific evidence"
OECD (2013)

# SSI framework

Targeted to all students, not just future career scientists

Makes use of relevant real-life contexts that are meaningful to learners

Ensures the connections to ethical, social and economic aspects are evident

If we want learners to **engage** and develop scientific literacy then we must shift from stand-alone and siloed disciplines…..

…towards replicating how science and scientists exist in the **real world**, with SSI contexts providing a means to integrate many socio-economic aspects Barab et al. (2007)

For students to be active and engaged participants in SSI they must "be interested in science and able to see its **relevance** to their world", clearly **linking** to the science skills and content knowledge stipulated in most school curricula. Bull et al. (2010)

Engagement of students in science is a long-standing challenge in our New Zealand schools, and even more so for Maori students.

Glynn, Cowie, Otrel-Cass, & Macfarlane (2010)


......where 'science' taught in many classes is experienced as distant and removed from the students' own worldview and knowledge base.

Much of our current science programme in our mainstream year 9 and 10 classes derives from the 'content' strands of L4-5 of the NZC, with the goal of preparing our students for future years in science and NCEA assessment.


"why do I need to know this for?"

"when will I ever use this?"

"I don't need science for my job!"

The value of including SSI into a junior science programme, is that it

**caters for all students**,

not just the minority funneled into career science (Sadler et al., 2007), and focuses on genuine and real-world issues "to which students can relate and which have potential to generate enthusiasm and purpose for learning" Sadler & Zeidler (2009, p.912).

The **purpose of science education** can be catergorised into two broad areas:

Roberts (2007)

## Vision I

To develop scientific skills and knowledge in a learner for future scientific endeavours and employment

## Vision II

Developing scientific literacy that would enable effective participation in society as a citizen, to confront, negotiate, and make decisions in everyday situations that involve science

# Vision I

Science literacy of Vision I

which is orientated towards the processes and products *within* the science discipline

# Vision II

Scientific literacy of Vision II

explained as "learning how science fits appropriately with … personal and societal perspectives for a more complete grasp of the issues"

many of those being complex **socio-scientific issues**

Roberts & Bybee (2014)

## Vision II

### Democratic and citizenship purpose

Enables learners to be “aware of the issues, have some ability to critically evaluate information, and be equipped to participate in debates and influence policy”
(Bull et al., 2010, p.9).

# SSI as a teaching approach

SSI allows learners to make **connections** between the science taught in class and the science experienced in everyday lives fulfilling a democratic citizenship purpose because the focal issues are **relevant** and can bridge school science and students’ lived experiences
(Zeidler et al., 2005).

# The New Zealand Curriculum (Ministry of Education , 2007c) tells us:

https://nzcurriculum.tki.org.nz


Lifelong learners need to be informed decision makers,

that are future focussed on significant issues,

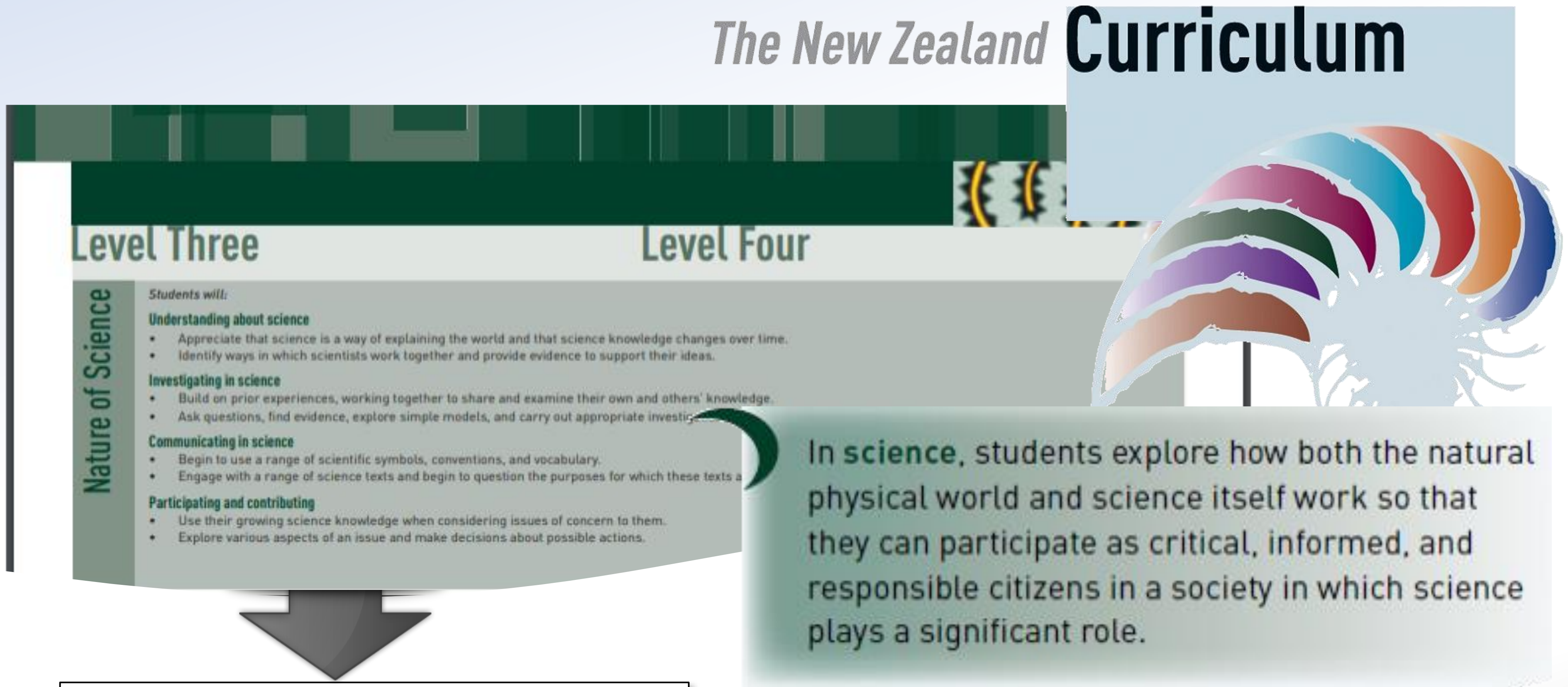
who make ethical decisions and act on them

https://www.nzcer.org.nz/remixingthekeycompetencies

## Key Competencies

are also essential components of an effective SSI teaching and learning programme, moving from an 'add-on' to meaningful drivers of context rich learning programmes

(McDowall & Hipkins, 2018).




https://nzcurriculum.tki.org.nz

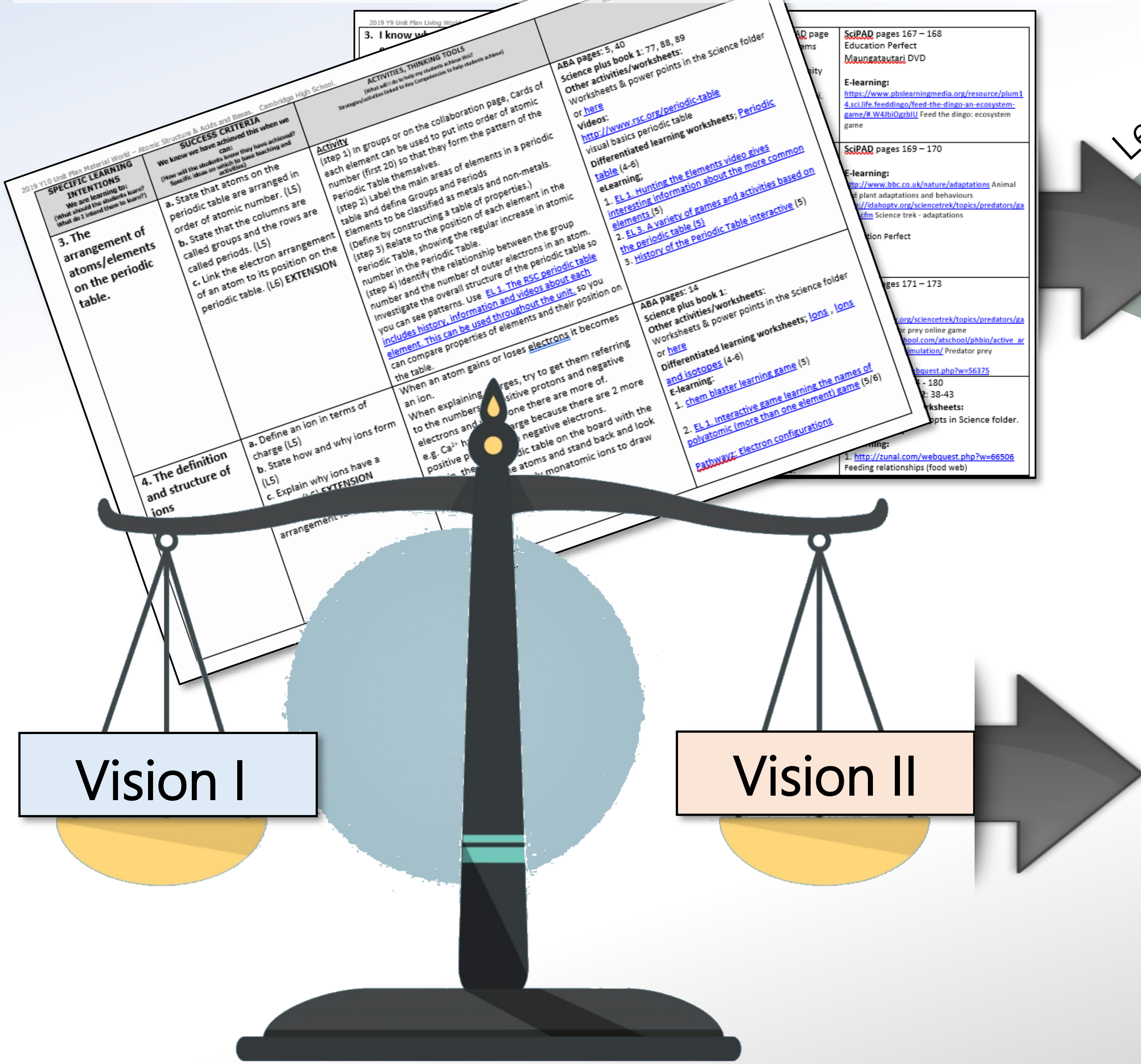
NZC articulating the need for the inclusion of SSI in a robust junior science teaching programme

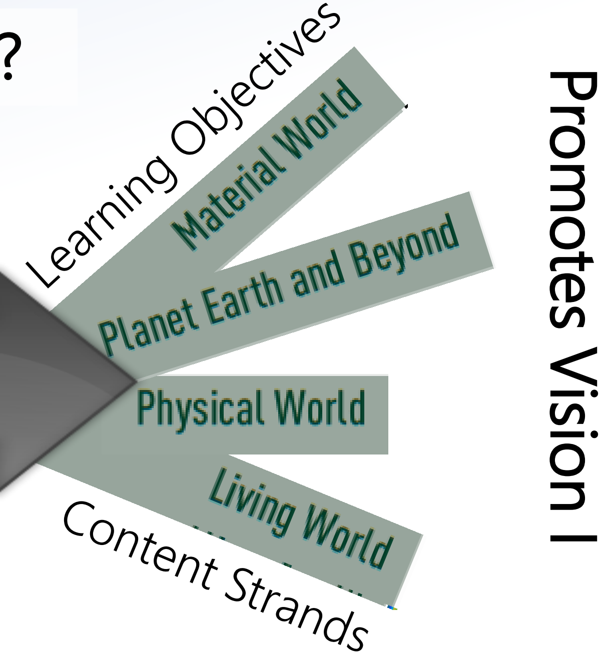
is this mirrored in our schools?

**Case Study: United States Educational curriculum**

"although general statements contribute to the SSI agenda, "the bulk of the documents tend to support more Vision I goals [namely the] acquisition of scientific content knowledge" Sadler & Zeidler (2009)

# But what's in our Junior Science Programmes?




**Inclusion of SSI**, as either smaller modules or larger contextual learning blocks, would reduce the imbalance of Vision I and II
Zeidler (2007)

Tension to **balance** the dual purposes Haglund & Hultén (2017)

# Science Capabilities


https://www.nzcer.org.nz/science-deck

The Ministry of Education developed **five science capabilities**

to create stronger connections between the NZC statement on "why study science?", the KCs, the NoS, and the core content strands, considering not just a student's abilities but their social and economic situation as well.

Hipkins (2014).

For students to effectively engage with real-life contexts, such as those found in SSI, a combination of capabilities to gather and interpret data, use, and critique, as well as understand the evidence and its representations, is required.

Hipkins, Bolstad, Boyd, & McDowall (2014)

# Effective Socio-Scientific Issues Pedagogy

Collaborative discussion of open-ended questions, **supported with genuine science** and authentically assessed
Wilmes & Howarth (2009)

Replicating **authentic real-world situations**, science, and scientific processes
Chinn & Malhotra (2002)

Moving from a mostly content-driven teaching programme towards a contextual emphasis, used by SSI, can be achieved with

## inquiry-based learning

McDowall & Hipkins, (2018)

Situated within **SSI contexts**; “societal issues with connections to science”
Sadler et al. (2017)

where inquiry learning can be used to establish those **connections** in a more meaningful way
Sadler et al. (2007)

# Inquiry-based learning

can be utilised as a stand-alone, student-led pedagogical approach, especially useful for the development of scientific literacy, as well "as a vital component in building a scientifically literate community"

Pedaste et al. (2015)

IBL has also shown to be an effective pedagogy to connect scientific knowledge with "a **kaupapa Maori worldview**."

Glynn et al. (2010)



Combined with SSI contexts, IBL enables better **understanding of problems**, even if SSI problems often do not have a consensus to solve them

Ariza et al. (2014)

requiring students to **explore, ask and develop questions, search for evidence-based answers**, and consider alternatives and impacts

Barab et al. (2007)

IBL can provide the tools to "**engage students** in an authentic scientific discovery process"

Pedaste et al. (2015)

while SSI provides an opportunity for many different questions that **tether science to societal and ethical aspects**

Sadler et al. (2007)

https://www.mantalab.com


https://www.amazon.com

A **narrative** used as a context to engage the students and create relevant links

Use of **inscriptions**, scientific resources that students can use to make evidence-based conclusions

# Components of an SSI Inquiry

Barab et al. (2007)

the process of **inquiry-learning** itself.

**Clear links** to social, moral, and economic aspects for the learners
Sadler et al. (2007)

**Scientific processes**


https://nasaeclips.arc.nasa.gov/teachertoolbox/the5e

*An example of a possible inquiry model: BSCS 5E instructional model* *Bybee (2009)*

# **Digital technology** (DT)/ICT for e-learning

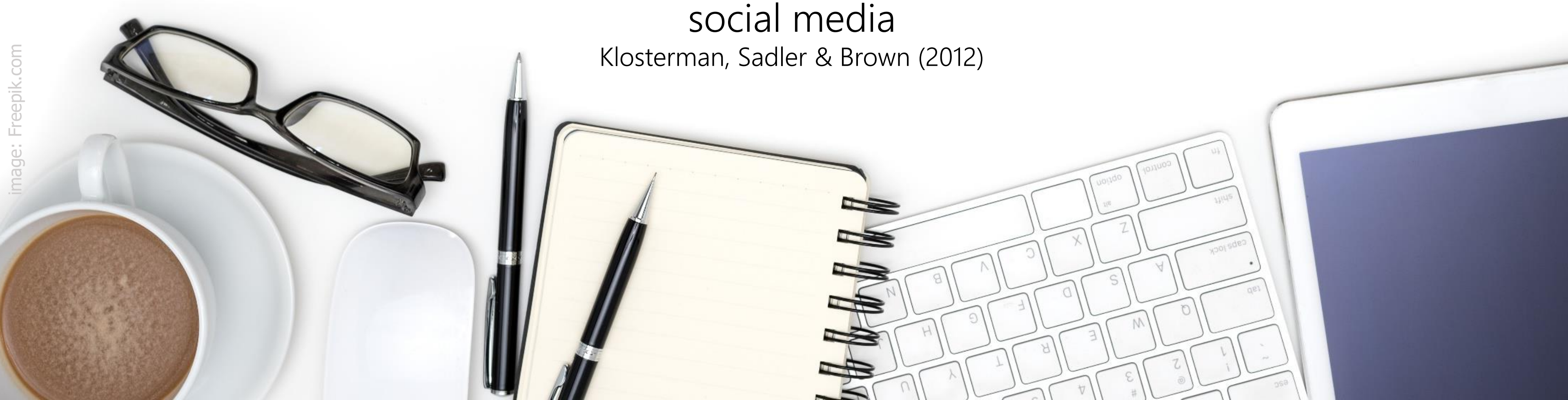
is a recommended method for students to explore the focal SSI

Sadler et al. (2017)

"information and knowledge **quickly and flexibly accessible**."
Wright (2010)

SSIs are by their nature, future-focussed and **contemporary**, with many printed resources being out of date within a few years, and DT provides an opportunity for students to connect with numerous scientific resources and differing points of view from social media
Klosterman, Sadler & Brown (2012)

**Inquiry-based learning** can also be more successfully implemented when students have access to digital technology
Pedaste et al (2015)



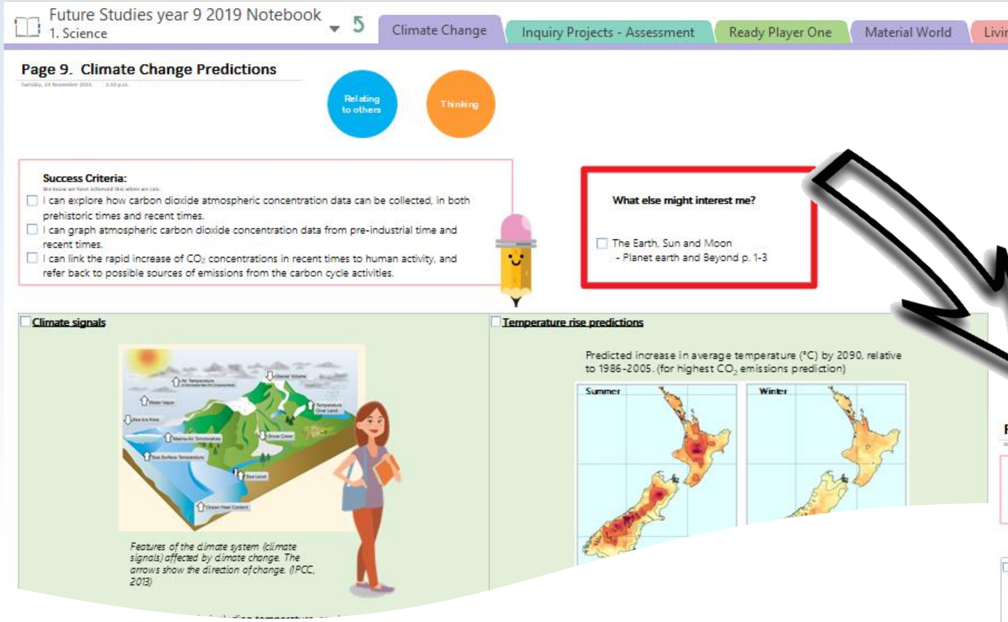
https://nzcurriculum.tki.org.nz


The NZC recommends the use of e-learning to make "connections by enabling students to enter and explore new learning environments"

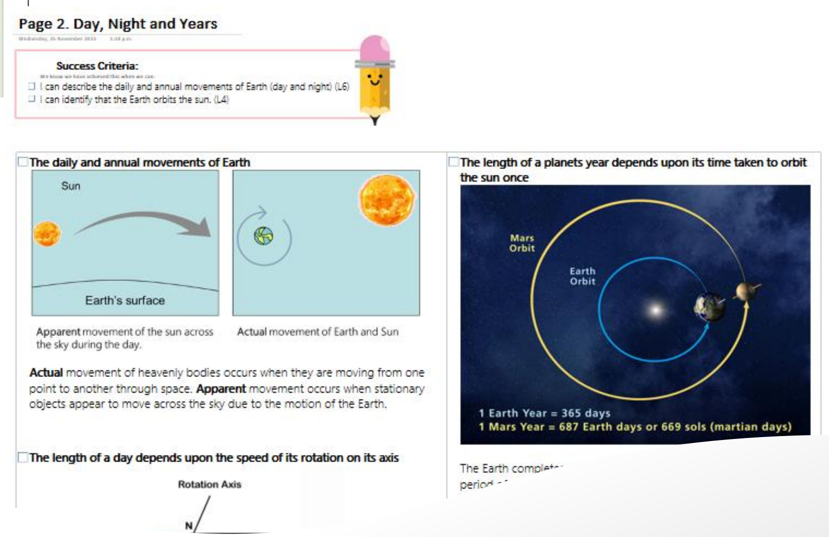
Digital Technology provides opportunities to participate in communities beyond the classroom, both important components of SSI teaching and learning
Sadler et al. (2017)

ICT can be used to investigate issues that have "more than one possible solution" to engage the students
Otrel-Cass, Cowie, & Khoo (2011)
and assist students to communicate their ideas.

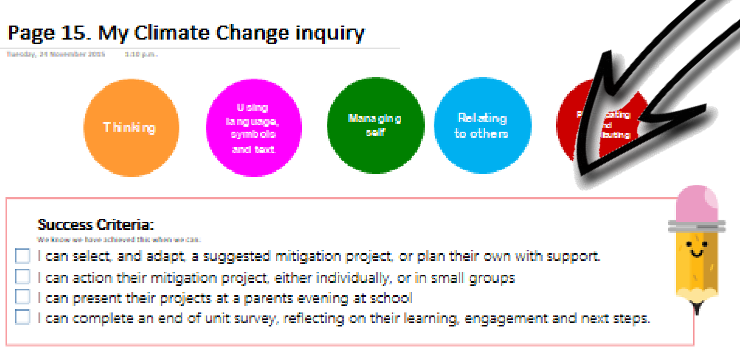
image: Freepik.com



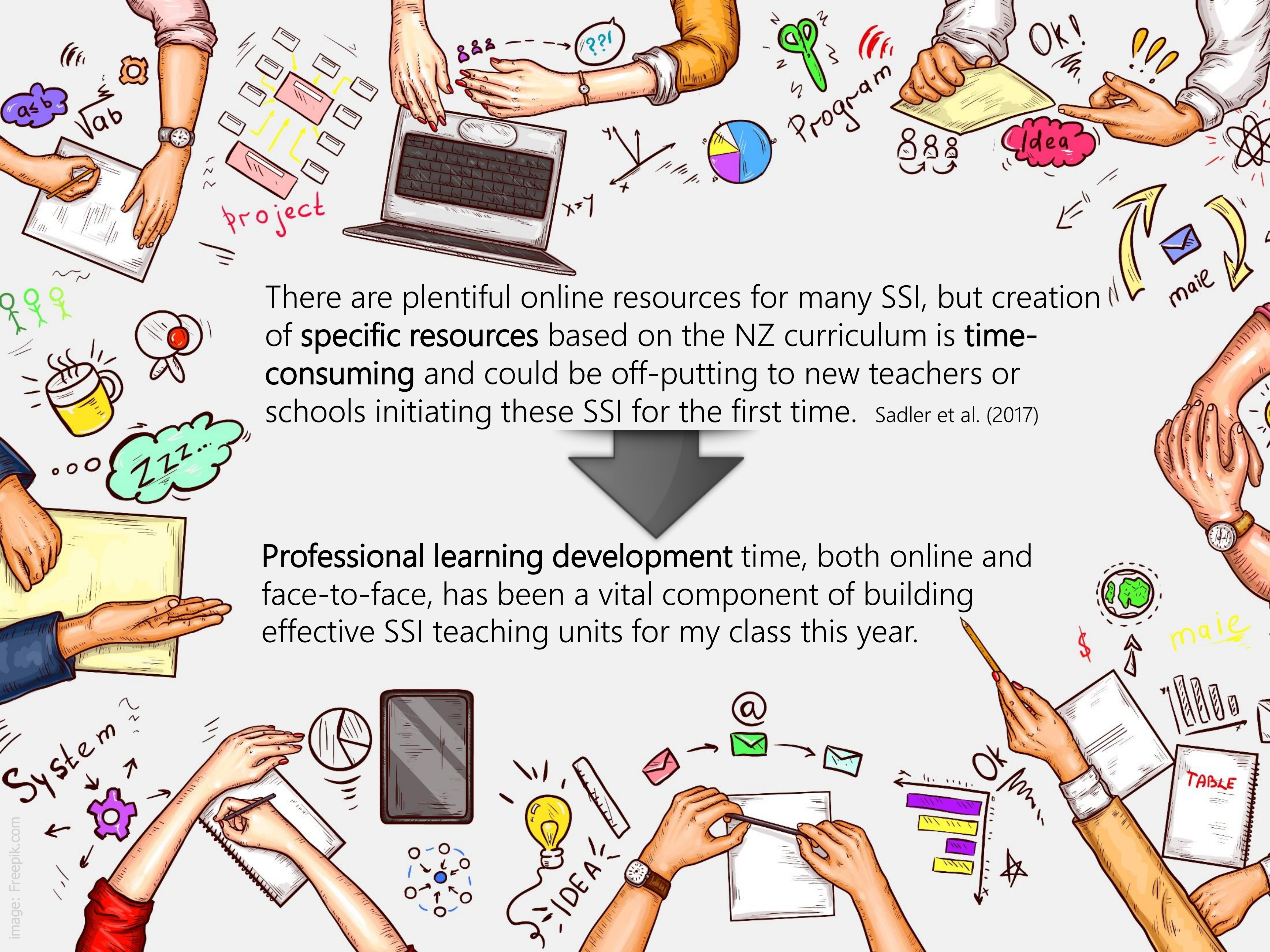

Within my school, there is a requirement that junior science students to have 'factual recall' assessment, sometimes **conflicting** with meaningful and balanced SSI inquiry
Barab et al. (2007)




ICT can reduce tension, between the external expectation of incorporating a traditional Vision I purpose of 'content learning' when focusing on a more engaging, Vision II purpose including SSI
Haglund & Hultén (2017)



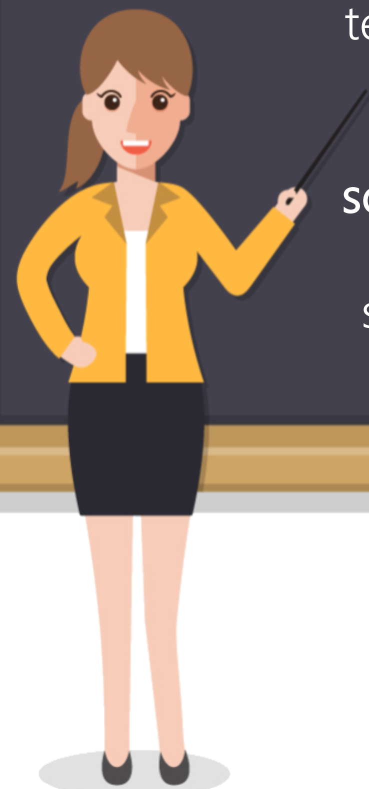

The digital environment allows me to move from a teacher-centred distribution of knowledge towards **student-centred ownership**, where student learning, and in many cases, collaboration between students, is extended **outside the classroom**



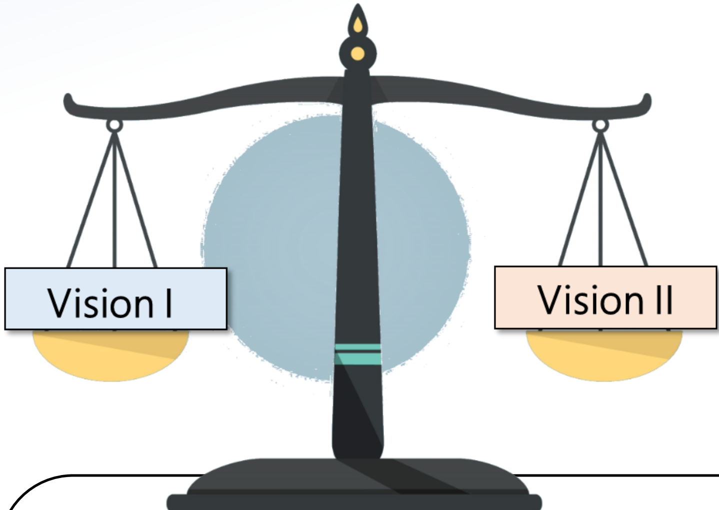

There are plentiful online resources for many SSI, but creation of **specific resources** based on the NZ curriculum is **time-consuming** and could be off-putting to new teachers or schools initiating these SSI for the first time. Sadler et al. (2017)

**Professional learning development** time, both online and face-to-face, has been a vital component of building effective SSI teaching units for my class this year.

# Summary



Many **traditional** junior science teaching programmes, including those at my school, are **influenced by their focus on science content,** and introducing the socio elements of SSI may seem to diverge from this path
Barab et al., (2007)




However, the need for <u>both</u> **Vision I and Vision II** is clearly called for by the NoS of the NZC, and students need an opportunity to explore different perspectives and make their contribution to issues that they will encounter in their present and future lives which is why the **inclusion of SSI** as part of their learning programme is so **important**.
Sadler & Zeidler (2004)

# Summary

SSI, used as a teaching approach in science, can be used to build **scientific literacy** in students, encompassing collaboration and communication, decision-making and evidence-based reasoning

Sadler & Zeidler (2004)

Students need to be able to **engage** in science, so that not only do they understand the underlying science concepts, as prescribed in the NZC, but so they become **informed participants** and problem solvers with the many SSI they will encounter in their lives as **future citizens**.

Sadler et al. (2017)


image: Freepik.com