Supporting information

Development of Systems Thinking in a large first-year chemistry course using a group activity on detergents

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CODEBOOK

Contents

A. Codebook for Systems Thinking (ST) characteristics 1 to 5 and what the students valued.

ST Characteristic 1: Recognize a system as a whole and not just as a collection of parts.

characteristic 1 is the ability to identify and organize the parts of a system, how they contribute to the whole system and to view the system as a whole (Figure S1).

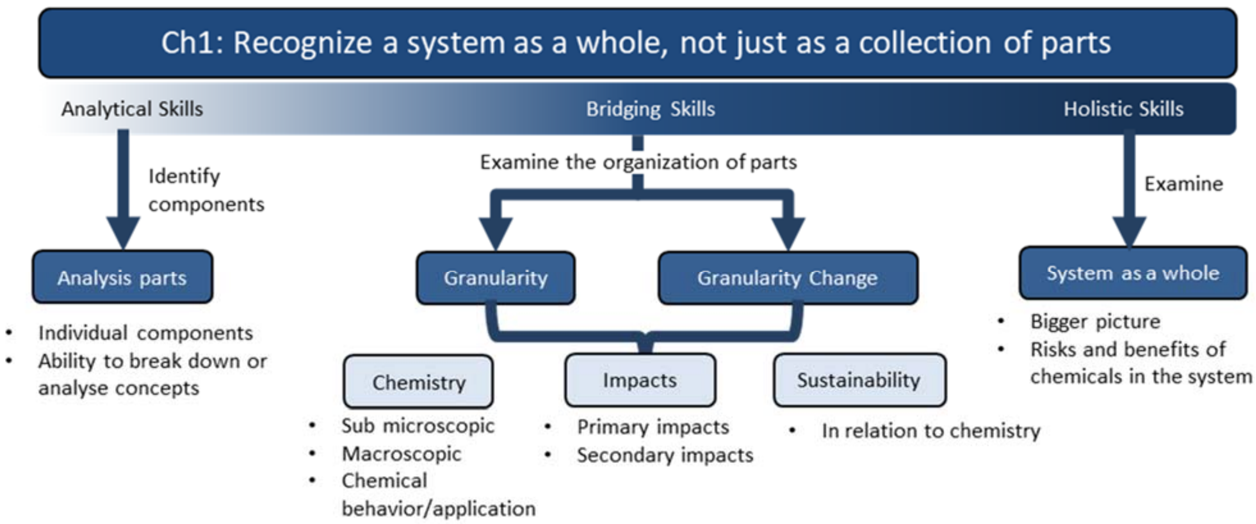


Figure S1: Data analysis of ST characteristic 1 for analytical, bridging and holistic skills

The analytical level of Ch1 involves identifying components of a system. The demonstration of analytical skills was gauged from the reflections by counting the number of concepts mentioned or by the detail given when they claim to have "learned to analyze the components of the system". More than half the groups did not mention "breaking down the parts", "analyzing ideas" or dissecting topics" and the majority of the students mentioned fewer than 3 concepts in their reflections. Thus, the students did not demonstrate analytical skills associated with Ch1 in their reflections to any significant extent. In evaluating the SOCMEs for analytical skills, the extent was judged to be partial if fewer than 15 new concepts were added, and clear if more than 15 new concepts were demonstrated. This decision was made after looking generally at how many concepts students added to their partial maps and was informed by Novaks's expectation that 30-40 concepts can be added to a map with 20 concepts.[1]

However, the. Partial maps students received already had about 15 concept more, so we expected 15 additional concepts.

Following the lead by Szozda et al. the display of the bridging aspect of Ch1 was analyzed by looking at the different levels of granularity students recognized in the system.[2] Directly connecting multiple different levels of granularity was considered to represent a clear demonstration of bridging skills. Levels of granularity were coded from three perspectives, i.e. chemistry at the sub-microscopic or macroscopic scales, primary impacts of chemicals and secondary impacts as well as considerations of sustainability connected to chemistry. The chemical behaviors or applications were grouped with the chemistry level of granularity, for example when students reflected on learning about the cleaning properties of surfactants, LAS's ability to result in foaming, how laundry detergents or surfactants work, how LAS can kills viruses and how LAS biodegrades.

Holistic skills require seeing the system as a whole. It was not possible to determine if students were able to do so from the SOCMEs alone. However, students could display holistic skills by reporting that they learned to see the bigger picture or contemplated the purpose of the systems thinking activity to better understand the risks and benefits of chemistry in moving towards global sustainability. Mentions of the "bigger picture" or "parts of a *system*" were judged to be a partial display of holistic skills. As an example, students showed holistic skills when they described their thinking or understanding of the "bigger", "larger" or "broader" picture as an outcome of the small concepts, ideas or parts that make up the system. In other words, they identified the parts of the system *and* their contribution to the bigger picture to form a unity. Additionally some students reflected learning about the risks and benefits of chemistry in their reflections, which was considered a clear display of holistic skills. The codebook for ST characteristic 1 is shown in Table S1.

Table S1. Demonstration of ST Characteristic 1

Skills	From	Partial	Clear
Analytical The system as parts	Reflections (overall judgement)	Reported on fewer than 2 concepts on a subsystem level or recognized that the system has "parts" or "elements" or key concepts.	Reported on 2 or more concepts on a subsystem level or reported on "breaking down or analysing" the parts in a system.
	SOCME	Added fewer than 15 new concepts to their SOCME.	Added 15 or more new concepts to the SOCME.
Bridging The levels of granularity of concepts within the system	Reflections	Student reported learning about concepts in one group of granularity. Chemistry Impacts SDGs A B C D E F	Student reported learning about concepts in two or more groups of granularity. Chemistry Impacts SDGs A B C D E F
	SOCME	Concepts demonstrated only one group of granularity. (colour applicable blocks) Chemistry Impacts SDGs A B C D E F	Concepts demonstrated two or more groups of granularity. (colour applicable blocks) Chemistry Impacts SDGs A B C D E F
Holistic The system as a whole with parts	Reflections (overall judgement)	Evidence of understanding either the whole (bigger picture) or the parts (small parts or concepts in the *system*)	Evidence of understanding both the whole (bigger picture) and the contribution of the parts (small parts or concepts in the system) to the whole.

A. Submicroscopic chemistry- Explanatory level: molecules, ions, atoms and electrical interactions
B. Macroscopic chemistry- Descriptive level: substances, physical and chemical properties and chemical reactions
C. Chemical behavior and application- Experiential level: chemistry behaviors or processes
D. Primary impacts - Positive or negative impacts directly caused by chemicals or chemical applications, behaviors or functions.
E. Secondary impacts - Positive or negative impacts caused by primary impacts and other concepts involving human use or influence.
F. Sustainability - How chemistry can be altered, manipulated or used to contribute to sustainability. The role of chemistry in sustainability.

ST Characteristic 2: Examine relationships and interconnections between parts of the system

Whereas Ch1 includes the structural organization of the components to form the whole Ch2 considers the relationships between the components. We modified the title for this characteristic such that all relationships are included not only those that contribute to cyclic behaviors. Informed by the ChEMIST table[3] and its interpretation by Szozda et al.[2], we considered types of connections when coding for analytical skills, and types of reasoning for evaluating bridging and holistic skills (Figure S2). Bridging skills include increasingly complex causal relationships between components and holistic skills culminate in multi-component causal reasoning that can explain cyclic behaviors in the system. We distinguished between identifying connection types and the reasoning applied to the connections in the SOCMEs or described in the reflections.

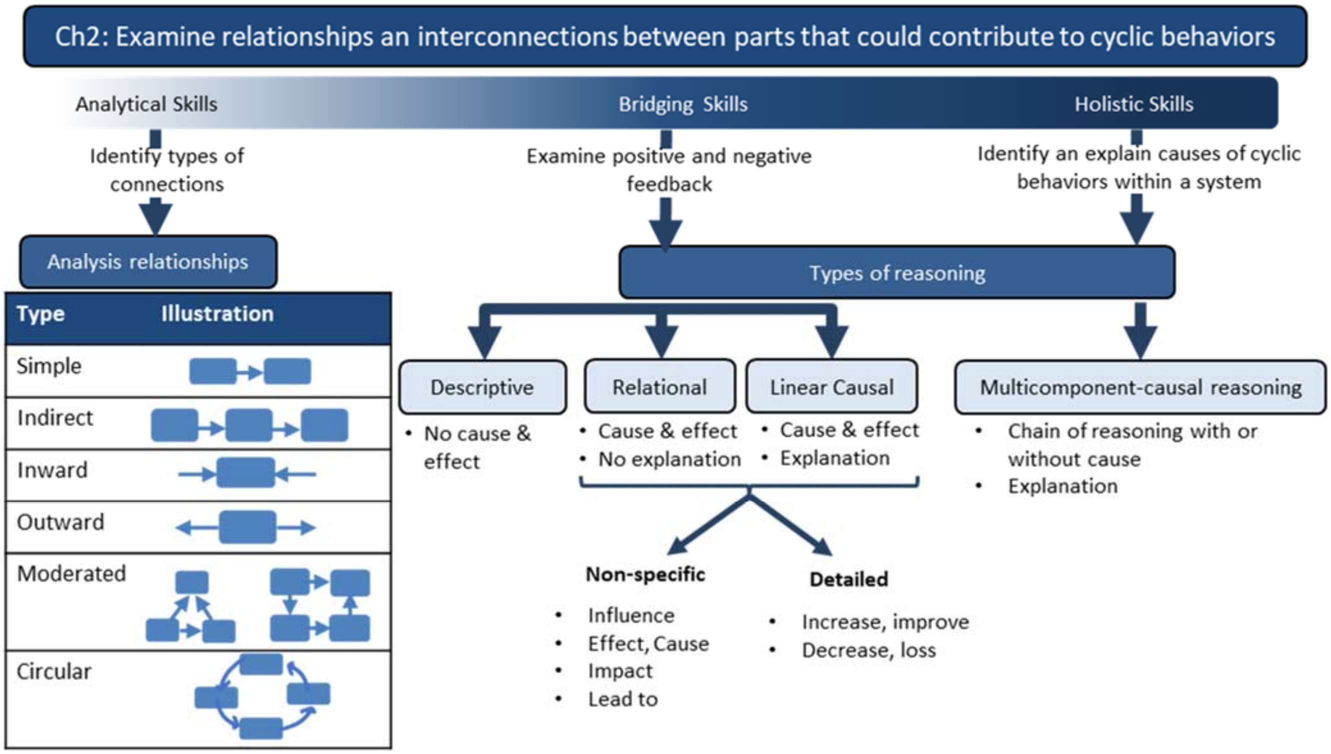


Figure S2: Data analysis of ST characteristic 2 for analytical, bridging and holistic skills

Where the reasoning behind the relationships was not described in the reflections, but students reported that they valued considering relationships between concepts on different scales or levels of granularity this was taken as an expression of analytical skills. Expressions of bridging skills were judged to be partial if the descriptions of the relationships did not include a clear cause or effect. If cause and effect were included, the display of bridging skills was judged to be clear. The codes for analysis of Ch2 are shown in Table S2.

Table S2. Demonstration of ST Characteristic 2

Skills	From	Partial	Clear
Analytical	Reflection	Reported on learning to identify relationships or referred to the relationships between concepts.	Reported on relationships between concepts that influence subsystems or the skill of connecting linear relationships with more than one input or output.
	SOCME	Only linear connections and propositions were added.	Both linear and more complex connections and propositions were demonstrated.
Bridging	Reflection	Reflections described relationships between components without indicating causes and effects.	Reflections include examples of cause-and-effect relationships.
	SOCME	Propositions are demonstrated that only show descriptive linking words.	Propositions are demonstrated that show relational reasoning or linear causal reasoning with or without direction or illustrate cyclic connections. Relational: (B1) no direction; (B2) direction Linear Causal: (C1) no direction; (C2) direction
Holistic	Reflection	Chain of reasoning expressing the multiple relationships without explanations and direction (B1) that could explain a potential cause of a cyclic behavior.	Chain of reasoning expresses the multiple relationships with or without explanations and with direction that could explain a potential cause of a cyclic behavior.
	SOCME	Multiple concepts are connected with linking words that have no direction and no explanation (B1) describing the potential causes of a cyclic behavior.	Multiple concepts connected with linking words that have direction and no explanation (B2) that describe the potential causes of a potential cyclic behavior and those that have explanations without (C2) or with direction (C1) that describe the potential causes of a cyclic behavior.

ST Characteristic 3: Identify variables that result in system behaviors, such as emergence.

Given the complexity inherent in the intervention, the terminology of emergence was not explicitly taught although the concept was deliberately included in terms of micelle formation in the chemistry of LAS and the phenomenon of foaming in rivers. Nevertheless, we were interested to see if any SOCMEs depicted multiple variables (analytical skills) contributing to an emergent property (bridging skills). We did not examine for holistic skills since students did not have the vocabulary to identify or explain emergent behaviors. For deductive coding, we visualized Ch3 as shown in Figure S3. However, no display of bridging skills was evident. Our codebook for Ch3 is summarized in Table S3.

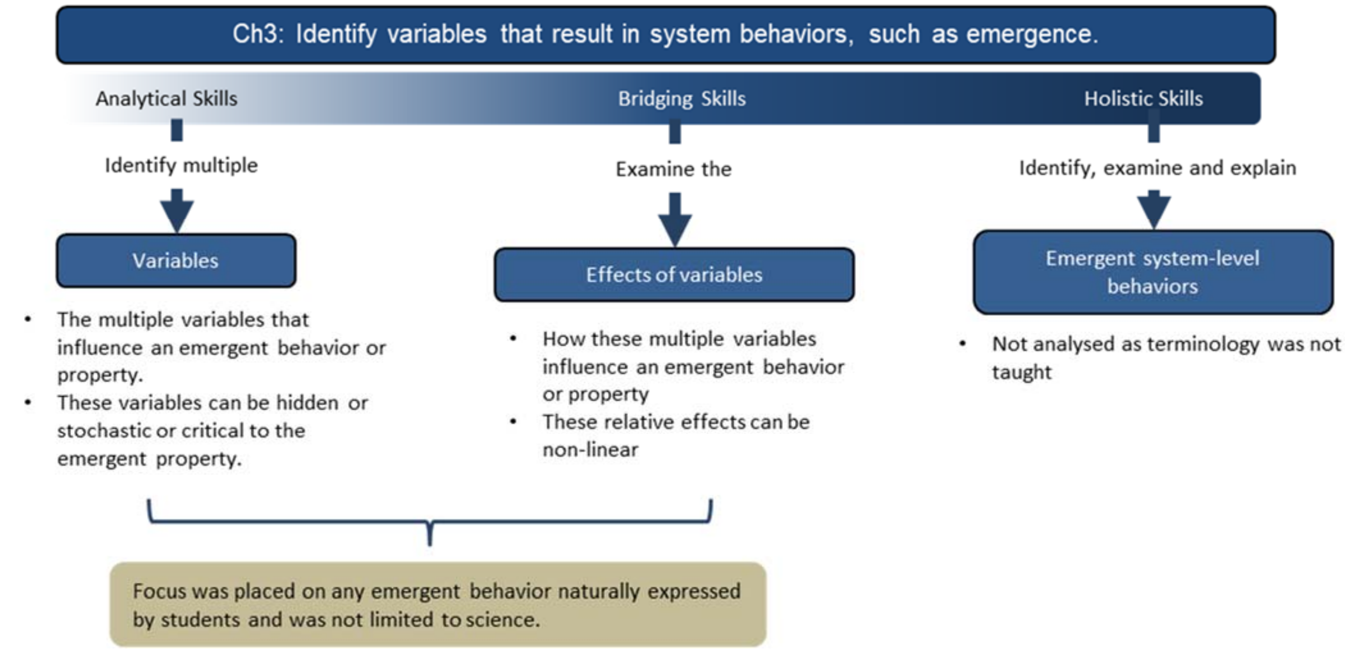


Figure S3: Data analysis of ST characteristic 3 for analytical, bridging and holistic skills

Table S3. Demonstration of ST Characteristic 3

Skills	From	Partial	Clear
Analytical	Reflection	Two variables contributing to a concept that could be an emergent property.	At least three variables expressed in context with connections to a potential emergent property or properties.
	SOCME	Two variables per emergent behavior expressed that make sense as demonstrated in linking words or concepts.	At least three variables per emergent behavior expressed that makes sense as demonstrated in linking words or concepts.
Bridging	Reflection	For the two variables expressed, one or two of the variables are described to understand how they influence the emergent property.	For the three variables expressed, more than two of the variables are described to understand how they influence the emergent property.
	SOCME	For the two variables expressed, linking words or concepts were demonstrated to describe how one or two of the variables affect the emergent behavior	For the three variables expressed, linking words or concepts were demonstrated to describe how more than two of the variables affect the emergent behavior

ST Characteristic 4: Examine how behaviors in a system change over time.

Dynamic systems change over time based on changes in the components and their relationships. An observation of changes in past behavior can lead to the identification of variables that affect the behavior of a system and an understanding of the influence of these factors in the past allows for prediction of the future behavior of the system under different conditions.[4] The ChEMIST table proposes the identification of system-level variables to constitute analytical skills, the description and explanation of system-level behaviors over time as bridging skills and the use of these patterns to predict future system behavior as holistic skills

The SOCMEs were populated with many variables that could change over time. However, “time” had to be mentioned specifically to interpret these elements as a display of Ch4. Statements such as “It also made me think about environmental health in the long run and how it affects us all, now and in the future” (group 14) and “how the activities that the world is practising are gradually leading to ecological imbalance” (group 29) were interpreted as demonstrations of analytical, not bridging skills. The interpretation of Ch4 is shown in Figure S4.

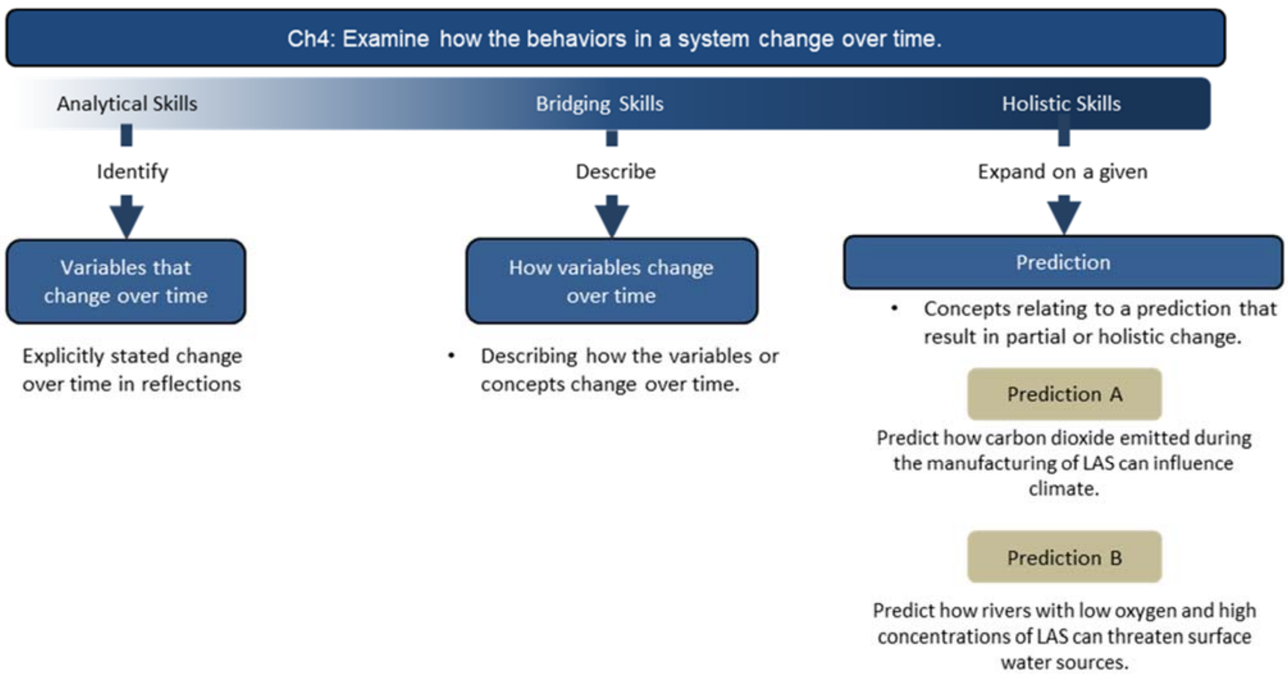


Figure S4: Data analysis of ST characteristic 4 for analytical, bridging and holistic skills

Holistic skills involve making predictions from trends in various conditions. Because this skill is challenging, students were guided by an instruction to expand their ideas and concepts on either prediction A or B:

Prediction A: In South Africa, coal-fired power stations depend on fossil fuels for the generation of electricity. SASOL uses the electricity for the fractional distillation to obtain the kerosene used in the manufacturing of linear alkylbenzene sulfonate. When coal is burned, carbon dioxide is emitted. The emitted carbon dioxide can be absorbed by aquatic systems, such as oceans. If excessive carbon dioxide is absorbed, ocean acidification can result, which threatens the life of coral reefs. Predict how carbon dioxide emitted during the manufacturing of LAS, can contribute to global warming and expand on the impacts of global warming and its contribution to climate change. You can expand on any of the following: changes in global temperatures, the frequency of natural disasters, malaria and typhoid outbreaks, the impacts of ocean acidification and acid rain on terrestrial and aquatic life.

Prediction B: The Balfour village is one example of a rural community that washes its laundry in the river. There are many other rural and urban communities that don't have access to tap water and thus also wash their laundry in the nearby rivers. The river water from these communities can be polluted with high concentrations of LAS and be oxygen-deficient. River water with decreased oxygen content can influence the rate of LAS biodegradation, the health of aquatic organisms as ecotoxicity changes, ecotourism, and the health of other community members. As the inland river water migrates towards the ocean predict how rivers with low oxygen and high concentrations of LAS can threaten surface water sources. You can expand on any of the following: changes in LAS concentrations, river health, ecotoxicity, biodegradation, ecotourism, human health, water-borne diseases, and biodiversity loss.

Any demonstrated or reported concepts that related to these predictions concerning only one subsystem were judged as a partial display of holistic thinking skills, whereas the impact on two or more subsystems was judged as clear. The codebook for Ch4 is shown in Table S4.

Table S4. Demonstration of ST Characteristic 4

Skills	From	Partial	Clear
Analytical	Reflection	Only one concept or variable is identified with explicit reference to it changing over time.	Two or more concepts or variables are identified with explicit reference to them changing over time.
	SOCME	Not assessed	Not assessed
Bridging	Reflection	One linking phrase is added to describe how this variable, concept or relationship changes over time (with a direct reference to change or time)	Two or more linking phrases added to describe how these variables, concepts or relationships change over time (with a direct reference to change or time)
	SOCME	Not assessed	Not assessed
Holistic	Reflection	Referred to the future behavior of the system or mentioned predictions relating to one of the two given scenarios that impacted only one subsystem.	Referred to the future behavior of the system or mentioned predictions relating to one of the two given scenarios that impacted two or more subsystems.
	SOCME	Concepts and relationships relating to Prediction A or B were added that impacted only one subsystem.	Concepts and relationships relating to Prediction A or B were added that impacted two or more subsystems.

ST Characteristic 5: Identify interactions between a system and its environment and the role of humans

For this characteristic, the ChEMIST table describes analytical skills as identifying and describing appropriate system boundaries, bridging skills as a consideration of the effects of the system its environment, and holistic skills as the consideration of the influence of humans on current and future system-level behaviors. Our interpretation of Ch5 is shown in Figure S5. In our analysis of the groups' demonstrations of Ch5, we judged the extent of analytical skills demonstrated from the number of sensible subsystem boundaries drawn. Since students were given such broad subsystem boundaries, we expected that it would be challenging for students to find smaller subsystems or new subsystems. Demonstration of sensible boundaries, in other words appropriate for added concepts, for only one subsystem was judged to represent a partial display of analytical skills. For example, inclusion of a concept belonging to the societal subsystem within the boundaries of the environmental subsystem was not considered to be a sensible boundary. Reasonable boundaries for two or more subsystems represented a clear display of analytical skills.

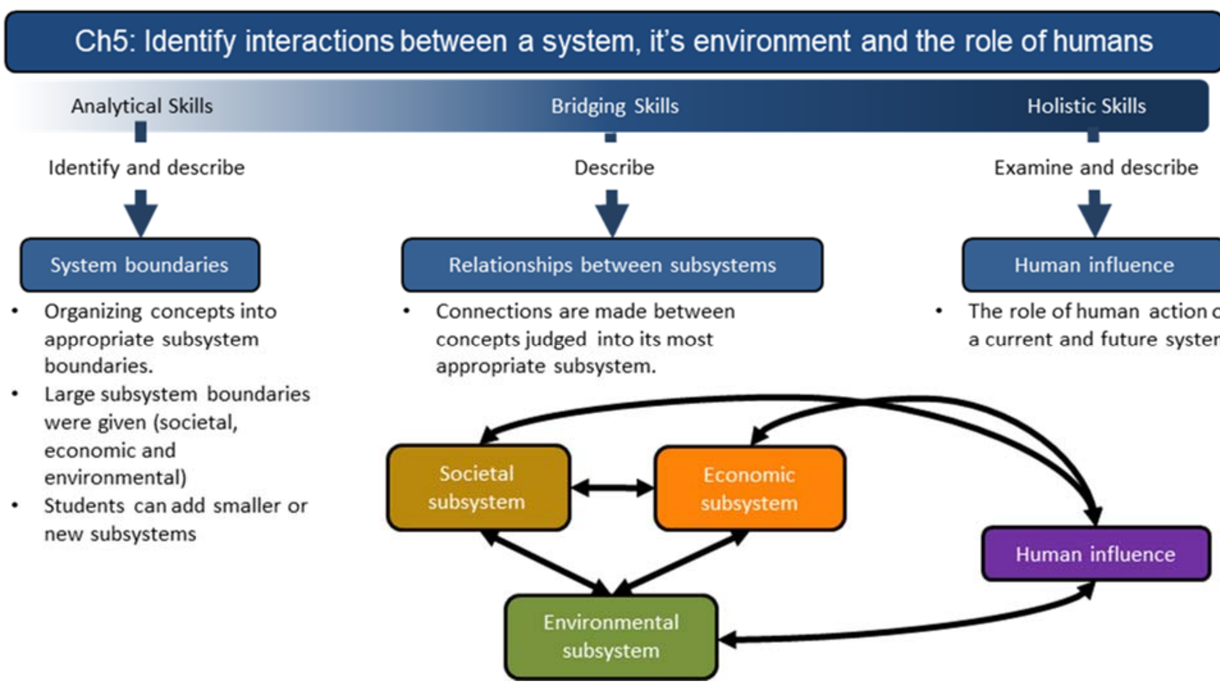


Figure S5: Data analysis of ST characteristic 5 for analytical, bridging and holistic skills

The intervention defined the system as influenced by LAS that incorporates the environment, the economy and society. This left little room to consider the influences of the system on other systems. However, a different definition of the LAS system as the laundry washing tub with detergent, would have redefined the economic, societal and environmental subsystems as *related systems*. Thus, we looked for the number of relationships between subsystems to indicate bridging skills.

Szozda et al. reported assessing holistic skills by looking for connections that describe how human action influences the system and by looking for concepts that are connected to a larger system.[2] In our study, holistic skills were analyzed by looking for concepts reported and demonstrated that relate to human influence such as manufacturing, production, consumption and use of detergents or LAS. We judged holistic skills to be partly displayed if students referred to concepts involving human influence on only one subsystem, but clear if the human influence was associated with more than one subsystem. Table S5 below shows the codebook for the analysis of Ch5.

Table S5. Demonstration of ST Characteristic 5

Skills Applied	From	Partial	Clear
Analytical (what students have drawn or reported)	Reflection	Students refer to only one subsystem in their reflections. Soc. Eco. Env. New	Students refer to more than one subsystem in their reflections. Soc. Eco. Env. New
	SOCME	A sensible boundary is drawn around the concepts and relationships for only one subsystem. Soc. Eco. Env. New	Sensible boundaries are depicted around concepts and relationships for two or more subsystems. Soc. Eco. Env. New
Bridging (our judgement of where concepts fit best)	Reflection	Only one relationship is reported that connects two subsystems. Soc.& Eco. Soc.& Env. Env. & Eco. Any & New	Two subsystems are connected more than once. Soc.& Eco. Soc.& Env. Env. & Eco. Any & New
	SOCME	Only one relationship is demonstrated between concepts from two different subsystems. Soc.& Eco. Soc.& Env. Env. & Eco. Any & New	Two or more relationships are demonstrated between concepts from different subsystems. Soc.& Eco. Soc.& Env. Env. & Eco. Any & New
Holistic (our judgement of where concepts fit best)	Reflection	Human influence is reported only within one subsystem or area of focus. Soc. Eco. Env. New	Human influence is reported within two or more subsystems or areas of focus. Soc. Eco. Env. New
	SOCME	Concept/s and relationship/s relating to human influence in one of the subsystems or areas of focus was/were added. Soc. Eco. Env. New	Concepts and relationships relating to human influence in two or more of the subsystems or areas of focus were added. Soc. Eco. Env. New

Self-reported Learning and codes for Talanquer's framework for Systems Thinking

Inductive coding of students' reflections on their learning through the activity yielded several codes that did not fit into the ChEMIST table but were aligned to two components of Talanquer's framework[6] for systems thinking, "a context-based focus" and "a sustainable action perspective". The code

"Chemistry is relevant" was revisited and found to align well with the "Context-based focus" component. We grouped the emergent codes "Sustainability matters" and "Ownership" within the component "A sustainable action perspective." We coded deductively for the third component of this framework "Mechanistic reasoning" and found that this code aligned with aspects of Bridging skills for Ch1 (A. Submicroscopic concepts and D. Primary impacts, Table S1). Recognizing that chemicals have benefits as well as hazards that need to be managed has been identified as important for sustainable action.[7-9] We deductively coded reflections for "Benefits & disadvantages" and found overlap with codes "Primary impacts" from ChEMIST table Characteristic 1 and "Human influence" from Characteristic 5, where students often mentioned the benefits and disadvantages of chemicals, usually LAS. Benefits, costs and risks must be considered with chemical knowledge in mind in sustainability decision-making.[2] These codes are shown in Table S6. Other codes that represented what students valued from the intervention are also included in Table S6.

Table S6. What students valued, expressed in the Student Reflections

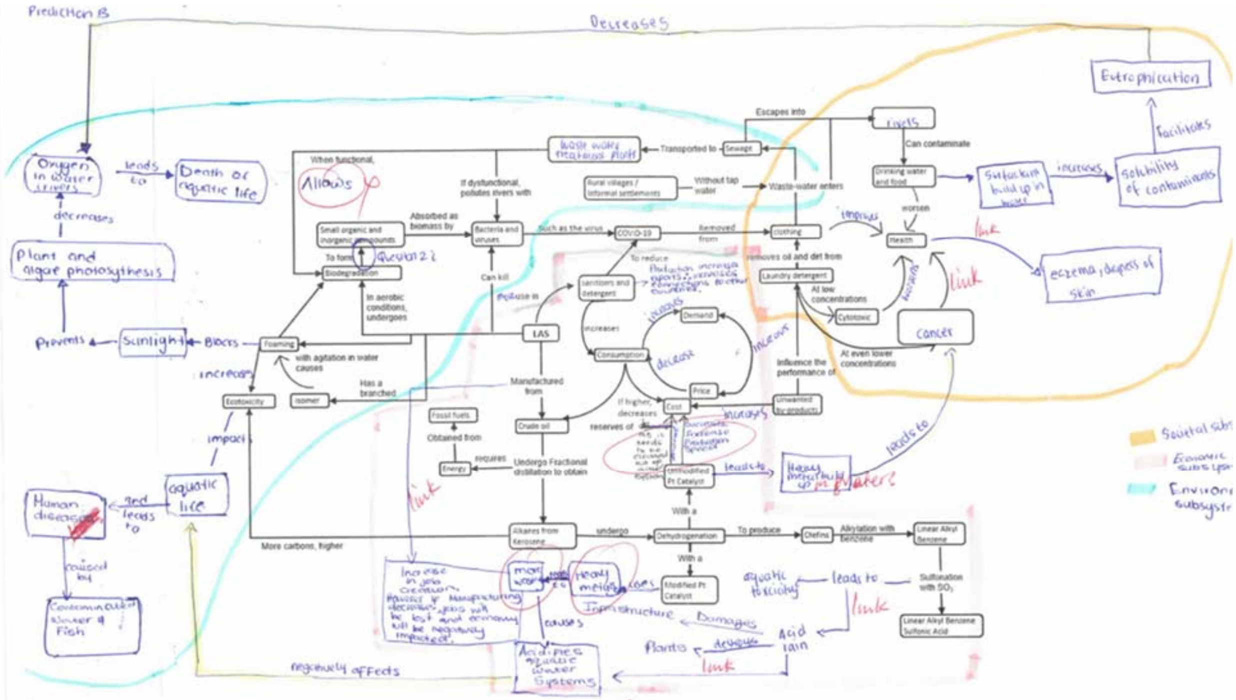
Code	Code description	Examples
Mechanistic reasoning	Apply this code if students mention learning about molecular-level chemistry. Students could refer to learning about sub-microscopic particles or their behavior.	*"I also learned about how surfactants such as LAS are produced, how they work and …"* *"it was interesting as I now understand how surfactants work when I am washing dirt on clothes on a chemical level."*
Benefits and disadvantages of chemicals	Apply this code if students mention that a chemical has advantages, but also disadvantages or reference to negative impacts that counter the benefits.	*"…how detergents benefit us and the impact that the LAS has on our environment, economy and our social lives "* *"Although LAS is beneficial...it's made of crude oil which can cause ecotoxicity which kills our aquatic life. It also causes foaming in our rivers which results in water contamination leading to a lot of diseases."*
Chemistry is relevant	Apply this code when students mention chemistry being relevant in the real world or their personal contexts.	*"I learnt that chemistry is broad, what we do does not stop in the lab but it also affects our environment, society and economy "* *"I learned that everything you do, no matter how small, has a domino effect on the world around you. Everything is connected and even something small like washing your clothes with harsh chemicals can have a huge impact on other people's lives, the environment and the economy."*
Sustainability matters	Apply the code if students claim to have learned that sustainability matters.	*"I learnt about the importance of knowing the negative impact that pollution has on the environment, animals and people and how sustaining resources is necessary and very*

		important for present and future generations." *"I, however, also believe that those who are knowledgeable about how to reach sustainability are liable for teaching others"*
Ownership	Apply the code if students reflect on what they will do or change in their day-to-day activities or daily choices that can contribute to a more sustainable future. Examples include "creating technologies", "educating people in their community", becoming a "more responsible citizen" or changing their thinking and way of doing to contribute to future sustainability.	*"These practicals gave me reason to evaluate my own use of chemical based products and what alternatives there are for me to use to improve my life and if they would improve sustainability as a whole in my life."* *"In these practicals I've also learned how I can play a role in lowering the effects of LAS in our environment by choosing my laundry detergents carefully, washing my clothes only when necessary and also by reducing the use of LAS in our rivers and dams."*
Other learning reflected, but not reported in this paper		
"systems thinking"	Apply this code if students mention learning about systems thinking or anything about systems thinking. The words need to be in the excerpt.	*" I have learnt that system thinking is very beneficial in the way to analyse data and to summarise data and to organise data to make it accessible to use." B395*
Group knowledge and different ideas	Apply this code if students gained knowledge from their group members and shared knowledge or multiple ideas in groups and have gained various perspectives.	*"I have also learnt a lot about group work. How different people contribute different ideas to come with solutions and linking the subsystems together. It is true that you can really learn so much from others" B40*
Group work and social abilities	Apply the code if students developed collaboration skills because of working together, "teamwork, "work in a group", "work in a team "and if they learned communication and listening skills.	*"I learned how to work in a team and how to communicate my ideas with others and to listen to their ideas." B40*
Group work and cognitive load	Apply the code if students refer to how groupwork has reduced the cognitive load associated with the task.	"I found that combining the knowledge of three students relieves stress levels and makes the questions much easier"B340
Soft skills	**Critical thinking** Apply the code of students state that they have developed "critical thinking" skills	*"I have gained critical thinking from the practical" B388*
	Problem solving Apply the code if students use the words "problem solving", "solve the problem" or to find a solution or "outcome" to a problem as they describe working towards a solution. Use the code if students refer to "approaching the problem" or if students state that they have learned "problem-solving skills"	*"I learned that it is important to think logically about a problem because any major problem can be broken down into much simpler, smaller steps." B327*
	Creativity Apply the code if students refer to thinking out of the box or if they gained creative thinking abilities, which allowed them to think differently.	"*the practical pushed me to think outside the box by linking scenarios."* B458
Visualization tools	**Concept mapping/SOCMEs** Apply this code if students have learned concept mapping skills or if they learned how to draw a SOCME diagram or anything relating to concept maps.	"*I learned about the importance of concept maps in summarizing and interlinking different concepts together to form a bigger picture that is easy to understand" B93*

Organization Apply the code if students report that they have learned how to organize ideas onto a SOCME, that they gained organization skills or that they learned how to organize data.	*"I have learnt that system thinking is very beneficial in the way to analyse data and to summarise data and to organise data to make it accessible to use." B395*

B. Examples of the coding for a high- and a low-scoring SOCME.

By way of illustrating the findings, two example SOCMEs were chosen to represent the outer markers within which most of the other SOCMEs could be found. SOCME A (Figure S6) and the associated reflections represented a more extensive display of Systems Thinking characteristics. These three students chose to expand the given partial concept map. SOCME B (Figure S7) was produced by two students representing the economic and societal subsystems without using the provided framework. Their third group member missed the session in which the SOCMEs were constructed. This group's reflections and their SOCME displayed no or partial systems thinking skills for each characteristic. However, they creatively related concepts to health risks and benefits and their concept mapping skills were more advanced than those of group A.



220 Figure S6. SOCME A: Student-generated SOCME expanded from a provided skeleton.

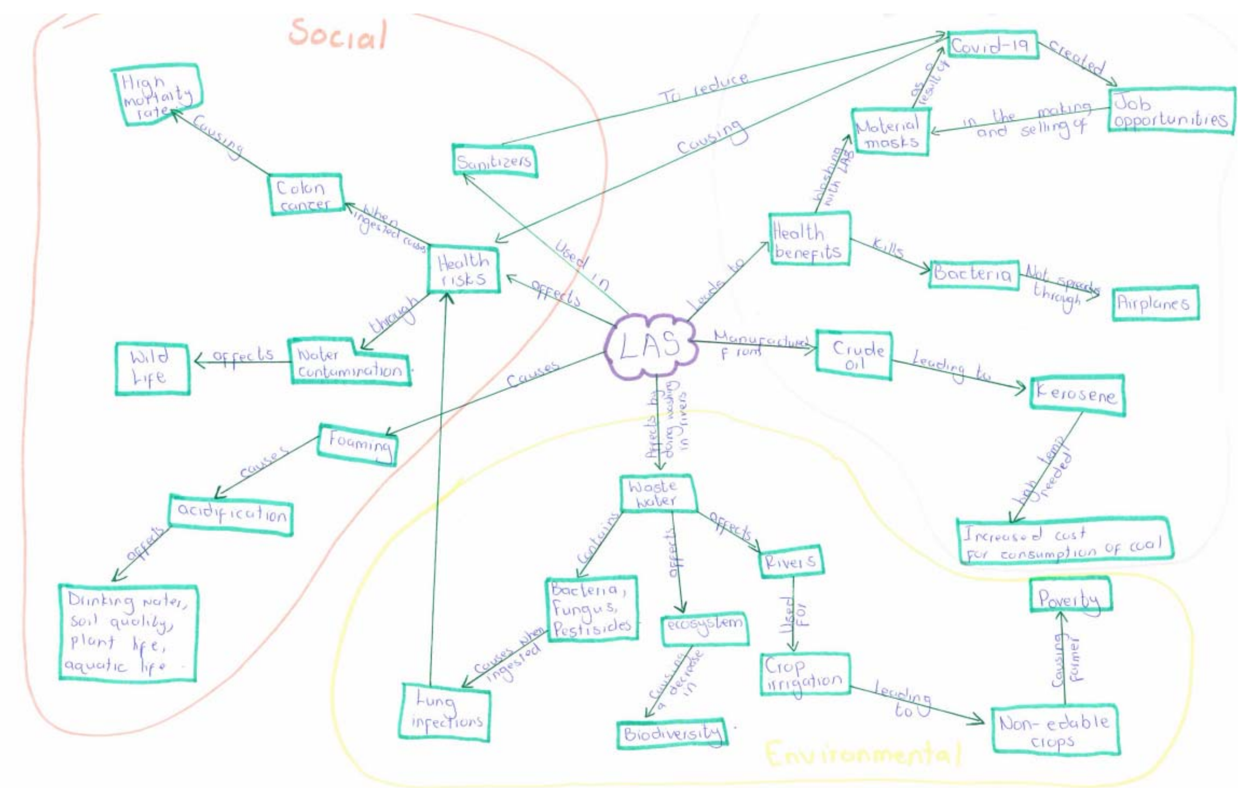


Figure S7. SOCME B: Student-generated SOCME that did not use the given skeleton.

The three students who contributed to SOCME A responded with detailed reflections of what they had learnt. Of the three students, two students were enrolled in the BSc Biological and Agricultural Sciences and one enrolled in BSc Genetics. Their SOCME lacked concept mapping skills as linking phrases were missing and concept blocks contained many ideas. SOCME B varies from SOCME A in that the group reflections of the two contributing students were short and less detailed and these students created their own new SOCME by using only a few of the given concepts and relating them to health risks and benefits, showing creativity and more advanced concept mapping skills. The students who contributed to this SOCME were enrolled for biological sciences. The analysis of SOCME A and B, coded using the codes depicted in tables 1 to 5 above, is shown in Table S7.

Table S7. Analysis table summarizing ST characteristics shown for SOCME A

Systems Thinking	From	Ch 1			Ch2			Ch3			Ch4			Ch5		
SOCME A		N	P	C	N	P	C	N	P	C	N	P	C	N	P	C
Analytical	Reflections			■			■	■			■					■
	SOCMEs			■			■		■		░	░	░			■
Bridging	Reflections			■			■	■			■				■	
	SOCMEs			■			■	■			░	░	░			■
Holistic	Reflections			■	■			░	░	░			■			■
	SOCMEs	░	░	░			■	░	░	░		■			■	
SOCME B																
Analytical	Reflections	■					■	■			■					■
	SOCMEs			■			■	■			░	░	░			■
Bridging	Reflections		■				■	■			■			■		
	SOCMEs			■			■	■			░	░	░		■	
Holistic	Reflections	■			■			░	░	░	■					■
	SOCMEs	░	░	░			■	░	░	░		■		■		

N: none, P: partial, C: clear The grey blocks show characteristics that were not analyzed.

C. Comparison of the subset of 13 coded SOCME groups with the full sample

Since detailed coding of SOCMEs proved to be very demanding, following the coding of the initial three SOCMEs during the process of refining the codebook, a decision was made not to code all 39 SOCMEs. Instead, a subset was chosen systematically taking every third SOCME from the sample. i.e. SOCMEs 6, 9, 12, 15, 18, 21, 24, 27, 30 and 33 were added to SOCMEs 1,2 and 3. These SOCMEs were analyzed in detail. The mapped out findngs for the subset associated with coding the reflections of the 13 groups was compared to that the 34 groups (shown in Table S8). Since the comparison was good, we were satisfied that the SOCMEs would be broadly representative of the sample. It is possible that by analyzing more SOCMEs, we could have discovered an increased display of Systems Thinking characteristics, but this analysis suggests that our findings for *RQ1: Prompted by the assignment, what Systems Thinking skills did students display/reflect?* are not exaggerated.

Table S8. Findings from the coding of the reflections from 34 groups compared to the coded reflections from a subset of 13 groups

Systems Thinking		**Analytical**		**Bridging**		**Holistic**	
		All 34	13 Subset	All 34	13 Subset	All 34	13 Subset
Ch1	Partial	9	5	8	5	10	8
	Clear	15	3	26	8	8	2
Ch2	Partial	6	5	3	1		
	Clear	28	8	31	12	5	
Ch3	Partial						
	Clear						
Ch4	Partial	3		2		3	
	Clear					4	1
Ch5	Partial	4	2	5	1	6	2
	Clear	26	9	2		17	7

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