



Using process data to inform partial credit scoring in interactive assessments

Beyond Results 2021

1 October 2021

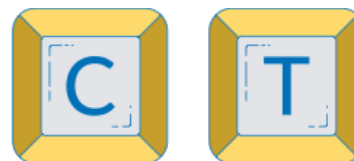
Daniel Duckworth

About ICILS

- **Cross national study of students' computer and information Literacy (CIL) and computational thinking (CT) and the contexts in which these competencies are developed.**
 - 2013, 2018, 2023+
- **Students in Grade 8 (or equivalent)**
- **Teachers of Grade 8**
- **School principals and ICT coordinators from each participating school**
- **National Centers (through a national contexts survey of country-level policies, curricula and resourcing)**



Computer & Information Literacy

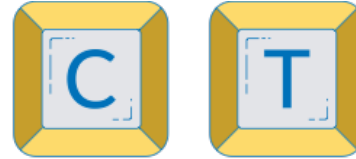


Computational thinking

Consumers and
producers of
digital information



Computer & Information Literacy



Computational thinking



Problem solvers
with digital
technologies

Caveats

- **Conceptual planning for ICILS (not a report of analysis)**
- **Old release items**

Overview

- **CIL linear skills task: Event-based response coding**
- **CIL authoring task: Process indicators**
- **CT coding task: Interim scoring**

CIL Linear skills task

Read the email from Sophia.

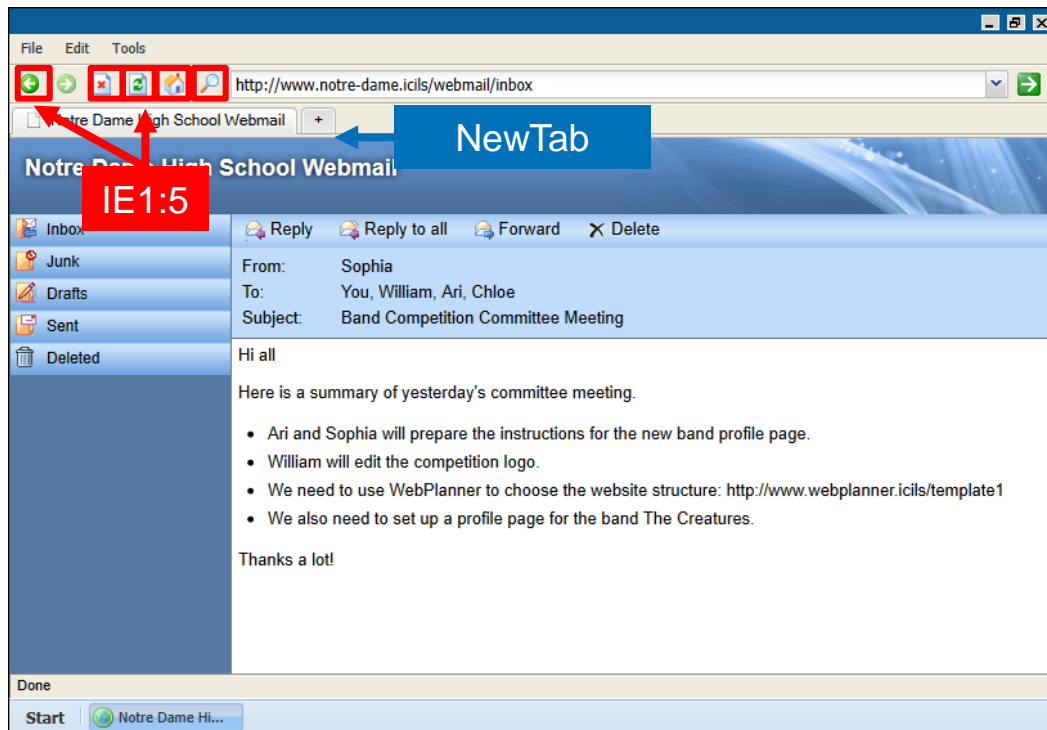
Go to the WebPlanner website.



CIL Linear skills task event annotations

Read the email from Sophia.

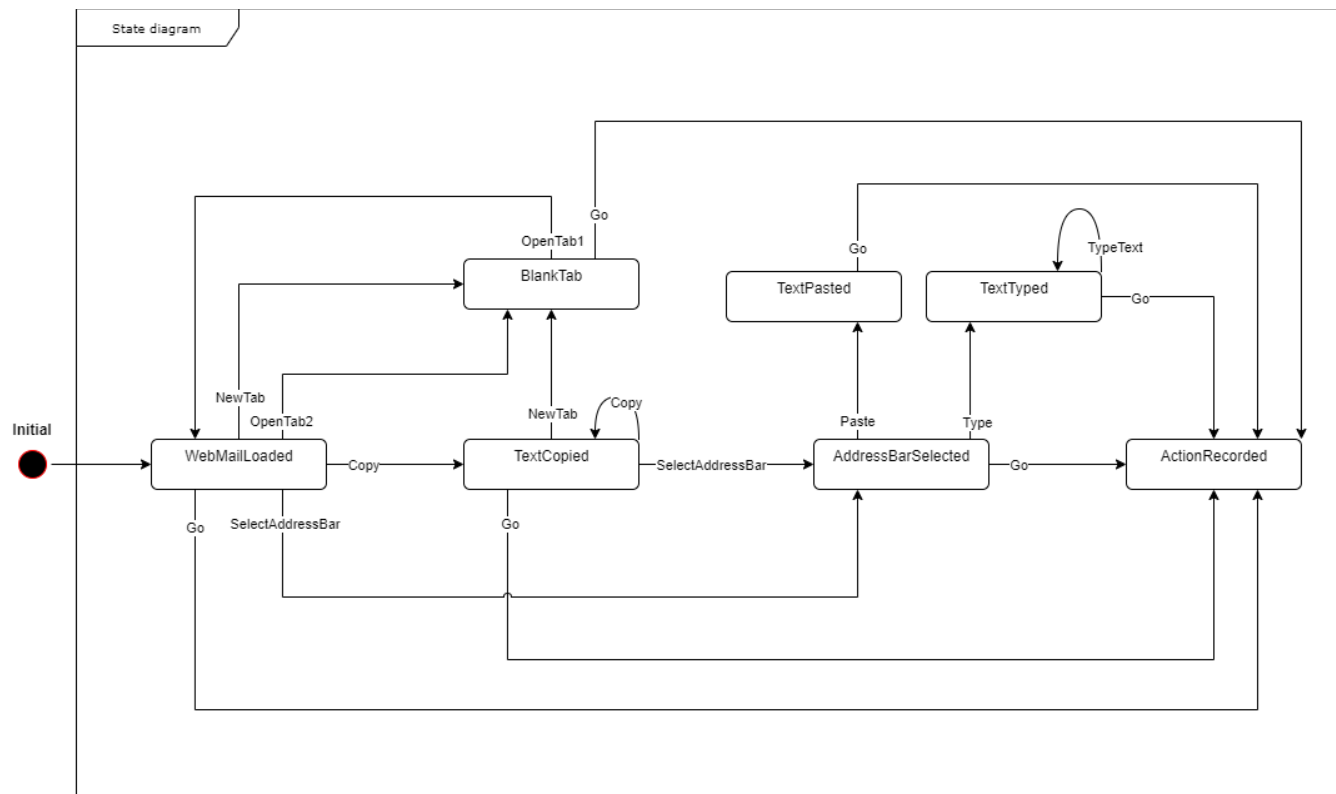
Go to the WebPlanner website.



CIL Linear skills task event taxonomy

Event ID	Data	Destination state	Event description
NewTab	N/A	BlankTab	Triggered when a new browser tab is created
Tab1	N/A	WebMailLoaded	Triggered when browser tab 1 is selected.
Tab2	N/A	BlankTab	Triggered when browser tab 2 is selected.
Copy	Mode (Keyboard, Mouse)	TextCopied	Triggered when selected text is copied.
SelectAddressBar	N/A	AddressBarSelected	Triggered when the browser address bar is selected.
Paste	Mode (Keyboard, Mouse)	TextPasted	Triggered when copied text is pasted.
Type	N/A	TextTyped	Triggered when text is typed in the browser's address bar.
Go	URL (User input) Mode (Mouse, Keyboard)	ActionRecorded	Triggered when enter the URL in the browser address bar is executed.
IE1	N/A	ActionRecorded	Triggered when the browser back button is selected.

CIL Linear skills task state diagram



Event-based response coding

Event ID	Data	Destination state
NewTab	N/A	BlankTab
Tab1	N/A	WebMailLoaded
Tab2	N/A	BlankTab
Copy	Mode (Keyboard, Mouse)	TextCopied
SelectAddressBar	N/A	AddressBarSelected
Paste	Mode (Keyboard, Mouse)	TextPasted
Type	N/A	TextTyped
Go	URL (User input) Mode (Mouse, Keyboard)	ActionRecorded
IE1	N/A	ActionRecorded

Exact match

```
from fuzzywuzzy import fuzz

ExpectedURLS = ["http://www.webplanner.icils/template1", "www.webplanner.icils/template1", "webplanner.icils/template1"]
UserInputURL = "webplanner.icils/template1"
ratios = []
for URL in ExpectedURLS:
    ratios.append(fuzz.ratio(UserInputURL, URL))
print(ratios)
for ratio in ratios:
    if ratio == 100:
        score = 2
    elif ratio >= 90:
        score = 1
    else:
        score = 0
print("Score: " + str(score))

[83, 93, 100]
Score: 2
```

Minor typo

```
from fuzzywuzzy import fuzz

ExpectedURLS = ["http://www.webplanner.icils/template1", "www.webplanner.icils/template1", "webplanner.icils/template1"]
UserInputURL = "ebplanner.icils/template1"
ratios = []
for URL in ExpectedURLS:
    ratios.append(fuzz.ratio(UserInputURL, URL))
print(ratios)
for ratio in ratios:
    if ratio == 100:
        score = 2
    elif ratio >= 90:
        score = 1
    else:
        score = 0
print("Score: " + str(score))

[81, 91, 98]
Score: 1
```

Double digit response coding

Score code	Score description
2	Executes one of the accepted URLs without error
1	Executes one of the accepted URLs with minor typo errors
0	Other

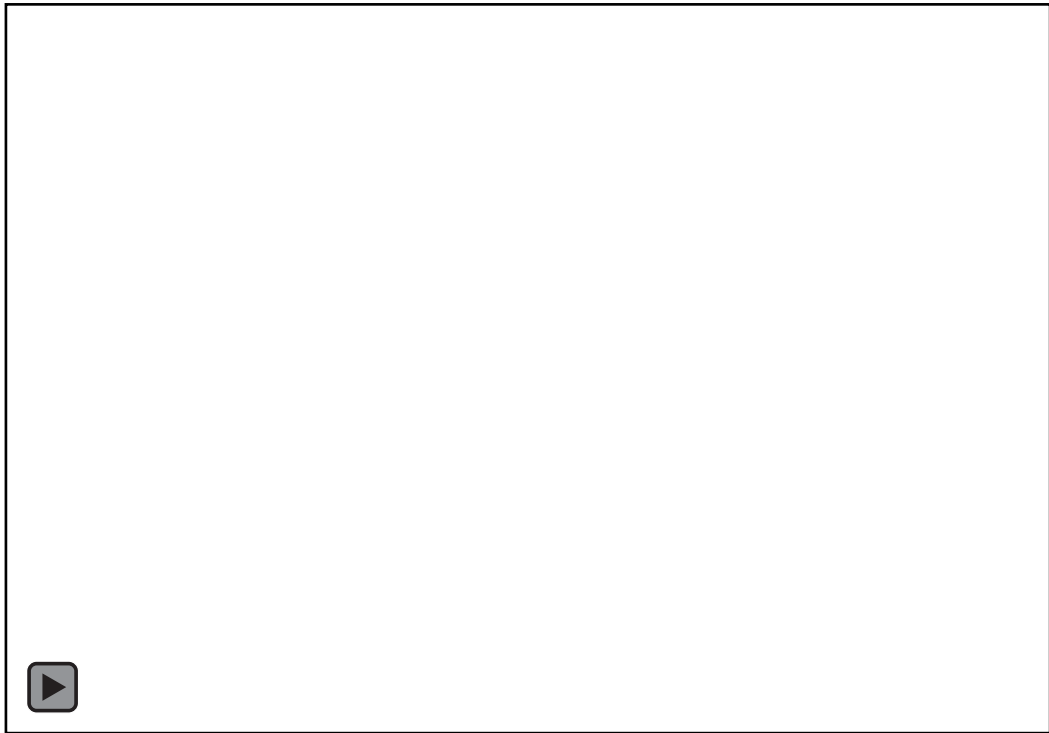
Method code	Method description
1	Typing
2	Keyboard shortcuts
3	Mouse context menus

Double digit code	Description
21	Executes one of the accepted URLs without error by typing the URL
22	Executes one of the accepted URLs without error by copying and pasting the URL with keyboard shortcuts
23	Executes one of the accepted URLs without error by copying and pasting the URL with mouse context menus

CIL authoring task

Create a new profile page for the band The Creatures.

Use the instructions in the email.



CIL authoring task event taxonomy

Event ID	Data	Empirical behaviour
Copy	N/A	Composing and editing information
Cut	N/A	Composing and editing information
Paste	N/A	Composing and editing information
Undo	N/A	Composing and editing information
Redo	N/A	Composing and editing information
Select	N/A	Composing and editing information
Delete	N/A	Composing and editing information
TypeText	NumberCharacters (int)	Composing and editing information
FormatHeading	Heading (Heading1:Heading6)	Formatting information
FormatInline	Inline (Bold, Italic, Underline, Strikethrough, Superscript, Subscript, Code)	Formatting information
FormatBlock	Block (Paragraph, Blockquote, Div, Pre)	Formatting information
FormatAlignment	Alignment (Left, Centre, Right, Justify)	Formatting information
ClearFormat	N/A	Formatting information
SetFont	Font (Andale Mono, Arial, Arial Black, Book Antiqua, Comic Sans MS, Calibri-Light, Courier New, Georgia, Helvetica, Impact, Symbol, Tahoma, Terminal, Times New Roman, Trebuchet MS, Verdana, Weddings, Wingdings)	Formatting information
SetSize	Size (8,10,12,14,16,18,20,22,24,26,28,30,32)	Formatting information
SetNumberedList	N/A	Formatting information
SetBulletedList	N/A	Formatting information
IncreaseIndent	N/A	Formatting information
DecreaseIndent	N/A	Formatting information
InsertTable	Columns (int) Rows (int)	Structuring information
DeleteTable	N/A	Structuring information
	Width (percentage) Height (int) Cell spacing (int) Cell padding (int) Border (int) Caption (bool) Alignment (None, Left, Center, Right) Border style (Solid, Dotted, Dashed, Double, Groove, Ridge, Inset, Outset, None, Hidden) Border colour (string) Background colour (string)	
ChangeTableProperties		Structuring information
InsertRowBefore	N/A	Structuring information
InsertRowAfter	N/A	Structuring information
DeleteRow	N/A	Structuring information
InsertColumnBefore	N/A	Structuring information
InsertColumnAfter	N/A	Structuring information
DeleteColumn	N/A	Structuring information
TaskBarButton1	N/A	Navigating
TaskBarButton2	N/A	Navigating
TaskBarButton3	TabNumber (Tab1:Tab2) Website (Website1:Website3)	Navigating
OpenTab()	TabNumber (Tab1:Tab2) Website (Website1:Website3)	Navigating

CIL authoring task event taxonomy

Event ID	Data	Empirical behaviour
Copy	N/A	Composing and editing information
Cut	N/A	Composing and editing information
Paste	N/A	Composing and editing information
Undo	N/A	Composing and editing information
Redo	N/A	Composing and editing information
SelectText	N/A	Composing and editing information
Delete	N/A	Composing and editing information
TypeText	NumberCharacters (int)	Composing and editing information
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ClearFormat	N/A	Formatting information
SetFont	Font (Andale Mono, Arial, Arial Black, Book Antiqua, Comic Sans MS, Calibri-Light, Courier New, Georgia, Helvetica, Impact, Symbol, Tahoma, Terminal, Times New Roman, Trebuchet MS, Verdana, Weddings, Wingdings)	Formatting information
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InsertTable	Columns (int) Rows (int)	Structuring information
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InsertColumnAfter	N/A	Structuring information
DeleteColumn	N/A	Structuring information
TaskBarButton1	N/A	Navigating
TaskBarButton2	N/A	Navigating
TaskBarButton3	TabNumber (Tab1:Tab2) Website (Website1:Website3)	Navigating
OpenTab()	TabNumber (Tab1:Tab2) Website (Website1:Website3)	Navigating

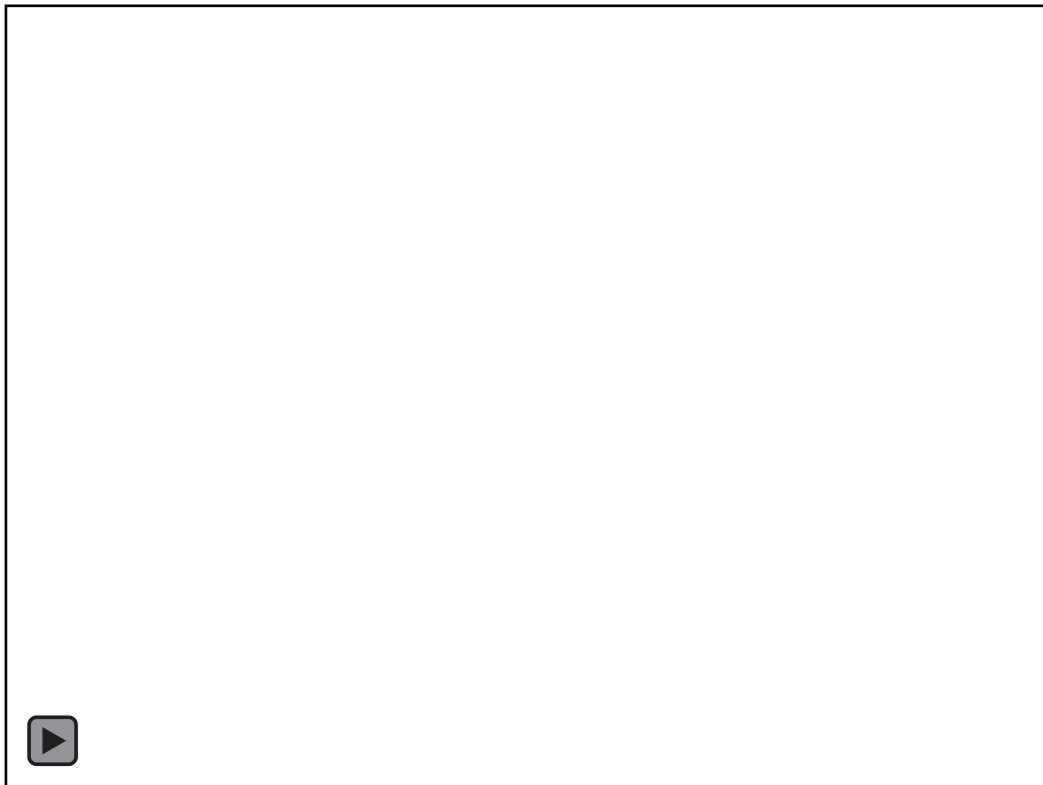
Latent process:

Planning

CT coding task

Use the 'repeat do' code block to make the drone drop water on the four dirt tiles with seeds.

The drone should not drop water on any grass tiles.



CT coding task event taxonomy: Work space

	Workspace (JSON) Commands (int) Output (JSON) Score (int)		
RunCodeButton			Triggered when the the code blocks in the work space are executed.
ResetOutputButton	N/A		Triggered when the the output and display are reset.
ResetWorkSpaceButton	N/A		Triggered when the state of the work space is reset to the default state.
AdjustSlider	Position (int)		Triggered when the slider to control the execution speed is adjusted.

```

"workspace": {
  "type": "controls_repeat_ext",
  "message0": "repeat %1 times",
  "args0": [
    {"type": "input_value", "name": "TIMES", "check": "Number"}
  ],
  "message1": "do %1",
  "args1": [
    {"type": "input_statement", "name": "DO"}
  ],
  "previousStatement": null,
  "nextStatement": null,
  "colour": 120
},

```

CT coding task event taxonomy: Output

	WorkSpace (JSON) Commands (int) Output (JSON) Score (int)		
RunCodeButton			Triggered when the the code blocks in the work space are executed.
ResetOutputButton	N/A		Triggered when the the output and display are reset.
ResetWorkSpaceButton	N/A		Triggered when the state of the work space is reset to the default state.
AdjustSlider	Position (int)		Triggered when the slider to control the execution speed is adjusted.

```

"output": {
  "GrassWaterCount": 1,
  "GrassSeedCount": 0,
  "GrassFertilizerCount": 0,
  "SeededDirtWaterCount": 4,
  "SeededDirtSeedCount": 0,
  "SeededDirtFertilizerCount": 0
},

```

CT coding task event taxonomy: Score

RunCodeButton	Workspace (JSON) Commands (int) Output (JSON) Score (int)		Triggered when the the code blocks in the work space are executed.
ResetOutputButton	N/A		Triggered when the the output and display are reset.
ResetWorkSpaceButton	N/A		Triggered when the state of the work space is reset to the default state.
AdjustSlider	Position (int)		Triggered when the slider to control the execution speed is adjusted.

T2F04XA (Targets)	T2F04WA (Grass)	Conceptual description	Code	Targets Recode
8	1	All 4 targets reached with only correct materials and no irrelevant targets.	4	2
8	0	All 4 targets reached with only correct materials and one or more irrelevant targets.	3	1
4, 5, 6 or 7	1	At least 2 targets with only the correct materials OR All 4 targets with the incorrect material, AND no irrelevant targets.	2	1
4, 5, 6 or 7	0	At least 2 targets with only the correct materials OR All 4 targets with the incorrect material, AND one or more irrelevant targets.	1	0
Fewer than 4	0 or 1	Fewer than 2 targets met	0	0

CT coding task event taxonomy: Score

RunCodeButton	Workspace (JSON) Commands (int) Output (JSON) Score (int)		Triggered when the the code blocks in the work space are executed.
ResetOutputButton	N/A		Triggered when the the output and display are reset.
ResetWorkSpaceButton	N/A		Triggered when the state of the work space is reset to the default state.
AdjustSlider	Position (int)		Triggered when the slider to control the execution speed is adjusted.

T2F0AA (Efficiency)	Comment	Responses (%)	Code
6	Minimum necessary commands	28	3
7,8,9,10	Repeat with additional commands	16	2
11 to 15	11 commands was the minimum necessary if not using the repeat	41	1
More than 15	More than 15 commands showed a good deal of redundancy	6	0

CT coding task event taxonomy: Score

RunCodeButton	Workspace (JSON) Commands (int) Output (JSON) Score (int)		Triggered when the the code blocks in the work space are executed.
ResetOutputButton	N/A		Triggered when the the output and display are reset.
ResetWorkSpaceButton	N/A		Triggered when the state of the work space is reset to the default state.
AdjustSlider	Position (int)		Triggered when the slider to control the execution speed is adjusted.

Targets Recode	Effeciency	Conceptual description	TEC score
2	3	All 4 targets using only the correct material with no irrelevant targets using no more than 6 commands.	3
2	2,1	All 4 targets using only the correct material with no irrelevant targets using between 7 and 15 commands.	2
2	0	All 4 targets in one row reached using only the correct material with no irrelevant targets using more than 15 commands.	1
1	1,0	At least 2 targets with only the correct materials and no irrelevant targets using any number of commands. OR All 4 targets with the incorrect material and no irrelevant targets using any number of commands.	1
0	N/A	Fewer than 2 targets met	0

Takeaway points

- **CIL and CT process data is directly construct relevant**
 - Process data could inform partial credit with respect to the relationship between the method and the outcome.
 - Event, state and output based coding allows for early iteration and testing of automatic scoring logic.
 - Latent process planning?
- **Interim scoring (scores over time) could provide new information about strategies and perseverance.**

Thank you!

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Researching education, improving learning

