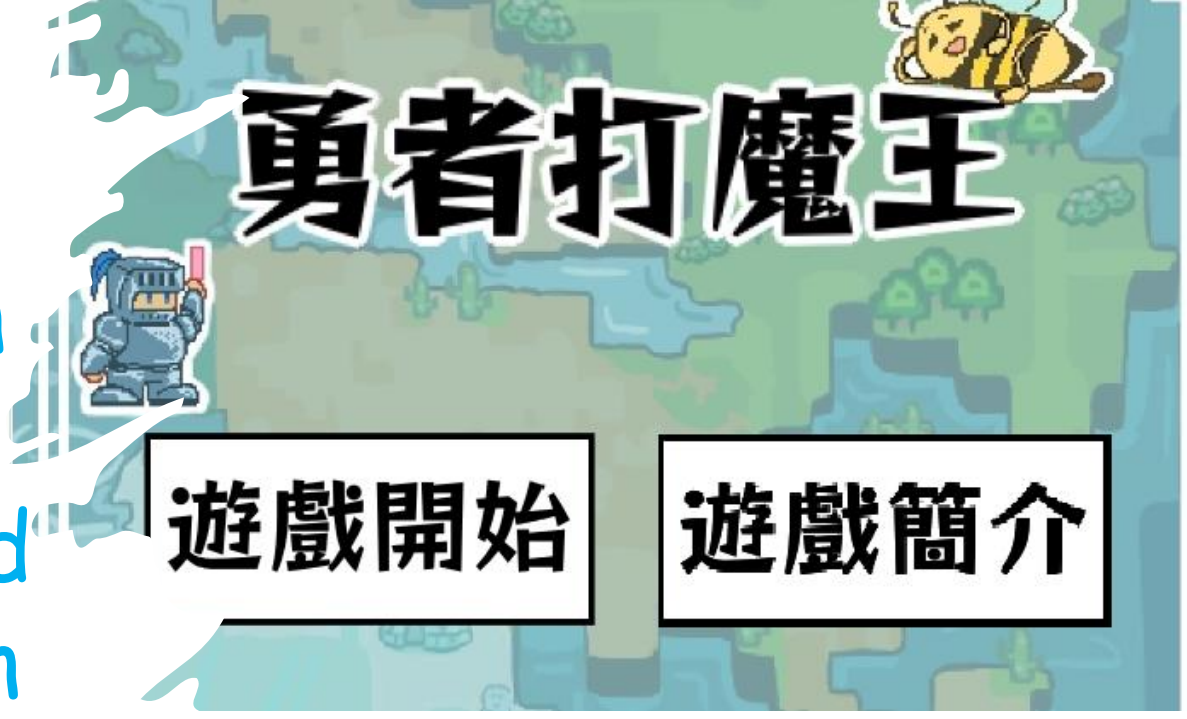
GEI 4001
STEM and its Application on Language Acquisition and Communication

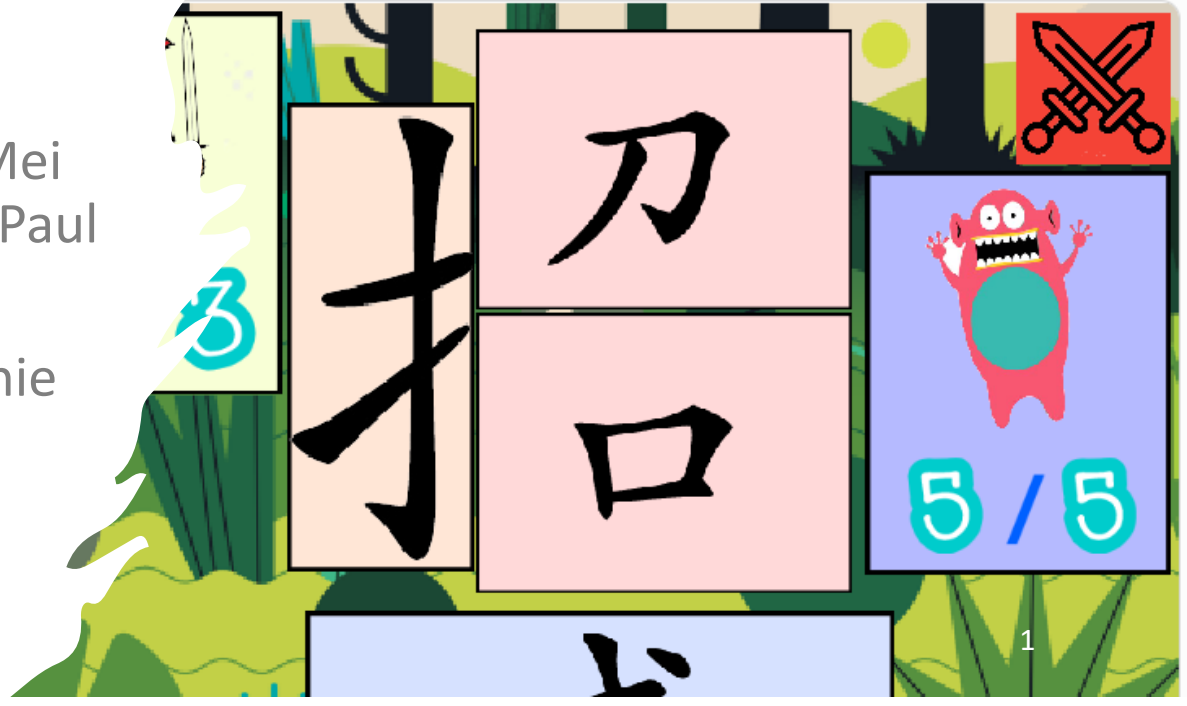


Lecturers

YEUNG Chi Ho Bill, MAN Mei Sum Agnes, CHOI Tat Shing Paul (SES, FLASS)

LAI Chi Shing, LI Zhen Jennie (CHL, FHM)

TO Hing Kwan Alastair (PS, FEHD)



Course Synopsis

- This interdisciplinary course offers participants the opportunities to **understand and experience the major approaches of STEM**, namely scientific inquiry and engineering design cycle, in solving cross-disciplinary problems in the field of language acquisition and communication. Through the course, participants

1. first **identify a problem** related to language acquisition and communication,
2. **develop a solution** by applying scientific inquiry and engineering design cycle,
3. and finally **reflect the impacts, feasibility, cultural and socio-economic implications** of the problem and the proposed solution in an interdisciplinary manner.

- Participants are required to disseminate their ideas, findings or products to experts in different areas, and are thus encouraged to integrate discipline-based knowledges in problem identification, solution development, dissemination and reflection, facilitating analyses on multi-disciplinary facets.

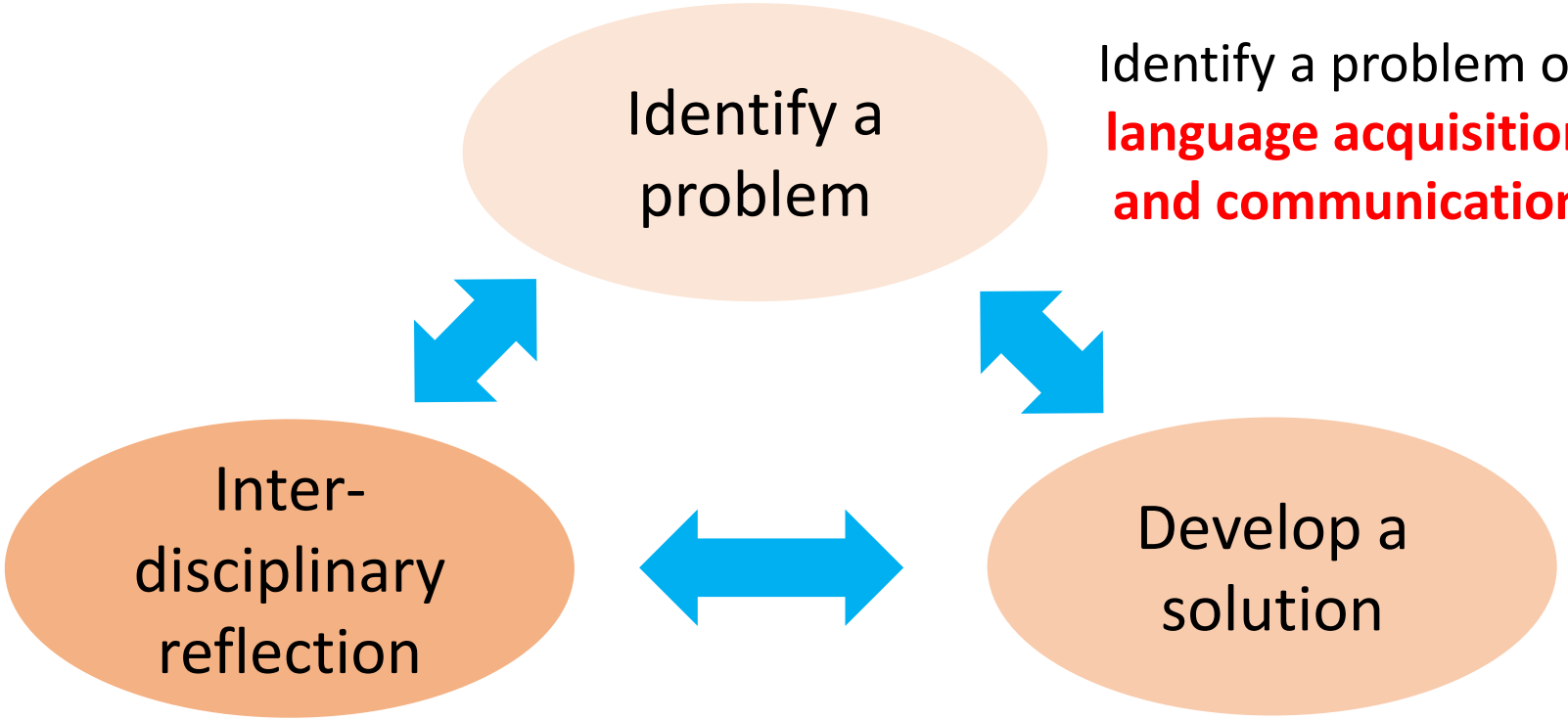
CILOs (and relation with GILOs)

- Course intended-learning outcomes (CILOs):

1. Understand the role of STEM in cross-disciplinary problems and **experience STEM in problem solving**
2. **Analyze and identify problems** related to **language acquisition and communication**
3. **Develop potential solutions** to the identified problems through the application of scientific inquiry and engineering design cycle, namely the two solution approaches of STEM
4. **Integrate interdisciplinary concepts** to analyze, disseminate and reflect their identified problem and developed solution from different angles

- GILOs: problem solving, critical thinking, oral communication skills, social interaction skills
- GELOs: knowledge, application and expression

Three Inter-connected Stages for Integration



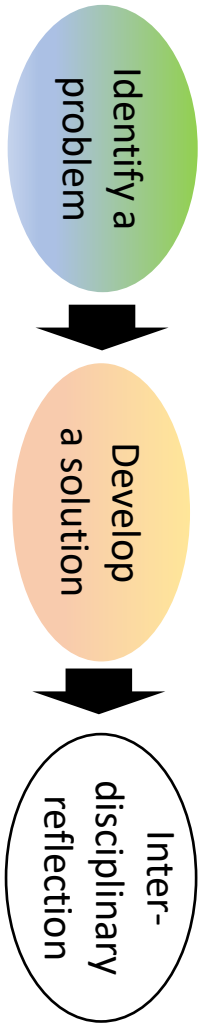
Identify a problem on **language acquisition and communication**

Reflection of impact, feasibility, **inter-disciplinary implications**

The rationale of STEM: **scientific inquiry + engineering design (Kelley 2016)**
Hands-on solution

References: Kelley, T. R., and Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM Education*, *3*(1), 11.

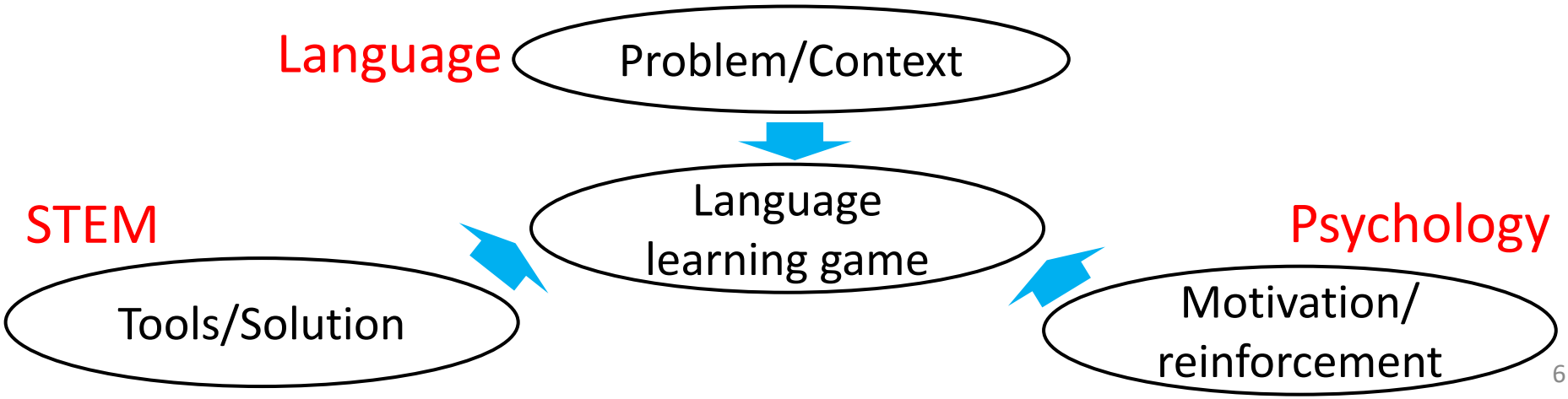
Week	Proposed Lesson Content	Lecturer			
		Bill YEUNG	Chi-Shing LAI	Alastair TO	
1	Introduction to STEM: scientific inquiry and engineering design cycle	✓			
	Communication among co-lecturers on the learning outcomes of students	✓	✓	✓	Co-planning
2	Understand language acquisition from the linguistic perspective	✓	✓		Co-teaching
3	Problems in speaking, reading and writing from the linguistic perspective		✓		
	Communication among co-lecturers on the learning outcomes of students	✓	✓	✓	Co-planning
4	Understand language acquisition and communication from the psychological perspective			✓	
5	Problems in speaking, reading and writing from the psychological perspective			✓	
	Communication among co-lecturers on the learning outcomes of students	✓	✓	✓	Co-planning
6	STEM Advances in the language word, e.g. AI for speech recognition	✓			
7	Hands-on workshop (1) – Creation of animation, language games	✓			
8	Hands-on workshop (2) – Creation of language games, mobile app	✓			
9	Student groups have consultation of proposal ideas simultaneously with 3 instructors	✓	✓	✓	Co-guiding
10	Students' proposal presentation: cross-disciplinary integration	✓	✓	✓	Co-assessing
	Discussion among co-lecturers on the guiding of students in the solution implementation/consultation period	✓	✓	✓	Co-assessing
11 - 12	Students work in group to implement and test their solution / Consultation with 3 instructors	✓	✓	✓	Co-guiding
13	Students' final project presentation: cross-disciplinary integration	✓	✓	✓	Co-assessing
	Discussion among co-lecturers before marking students' final reports	✓	✓	✓	Co-assessing



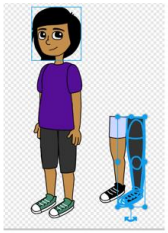
Interdisciplinarity achieved?

- In GEI4001, we have very different disciplines: **STEM, Language, Psychology**
- Students are either from STEM, or language, or education, etc.
- Course design – **integration through product-making**:

1. Provide students with knowledge from the three disciplines
2. Assessment: make a **language-learning game**, and a good product must well integrate the three disciplines (as we can see from the exemplar products)

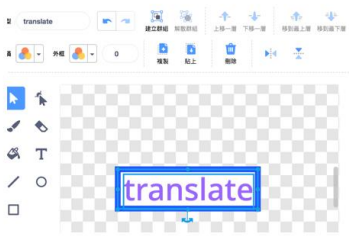


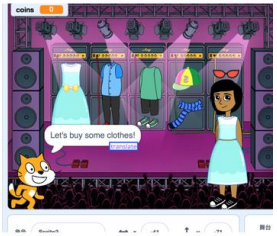
Integrating the 3 disciplines
Exemplar Student Product (1)

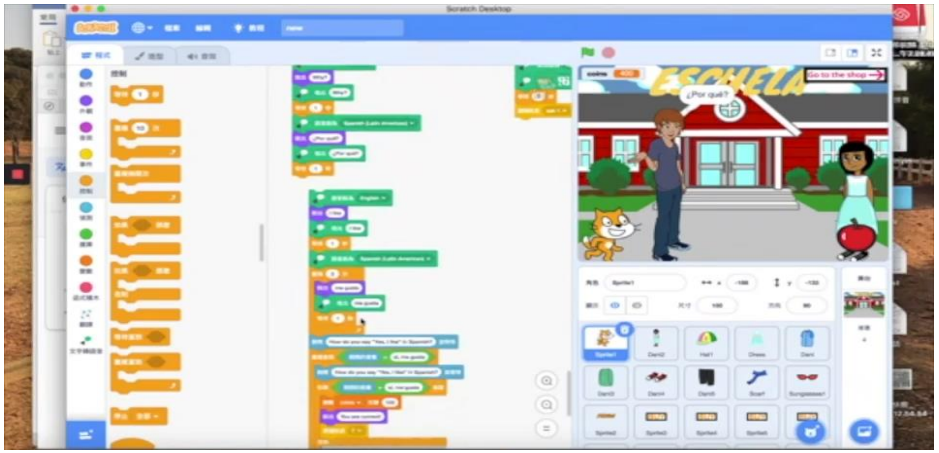


Problem identified:

Disconnection between language learning and authentic application of language







Solving the problem:

Application of STEM: Application of design cycle, making a language learning game with Scratch

Application of Psychology: how to motivate players to stay in the game (positive reinforcement)

Exemplar Student Product (1)

- Application of **Design Cycle**:

Improvement (1)
Poor instruction

→ Provide more instructions

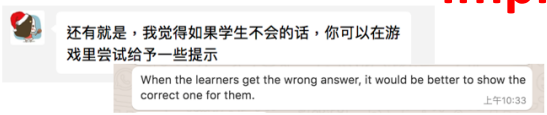
Improvement (2)
difficult to follow

- →assist with their learning

Testing and Evaluation

Improvement

1. Provide tips

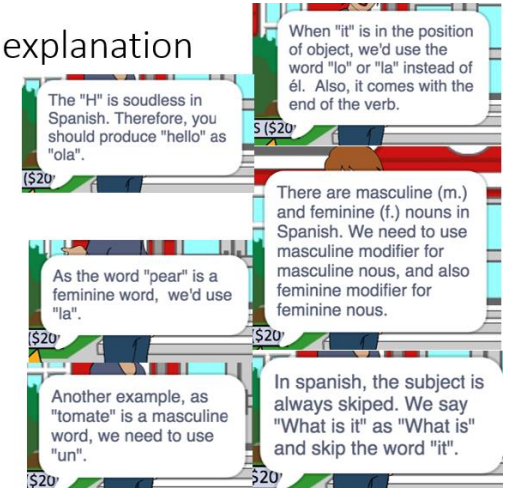


-designed with their most possible errors
→Missing the accent mark
→Missing articles

3. Provide with clear explanation

- Pronunciation
- Grammar
- Examples

*Learn from what they known



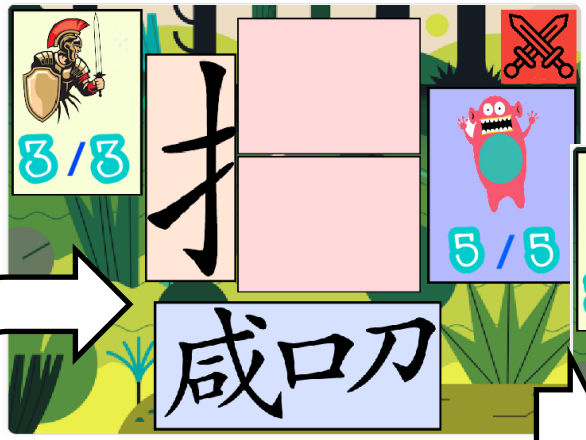
Integrating the 3 disciplines
Exemplar Student Product (1)

https://scratch.mit.edu/projects/387563528

Integrating the 3 disciplines
Exemplar Student Product (2)

https://scratch.mit.edu/projects/514075147/

Integrating the 3 disciplines
Exemplar Student Product (3)



https://scratch.mit.edu/projects/514069936

Integrating the 3 disciplines Exemplar Student Product (1)

- In the **reflective report**, students reflect on their **new understanding on language learning, psychological motivations, STEM and design cycle**, and their **integration:**

Student 1

- After studying this course, I find that **there are linkage between language, psychology and STEM**. **These 3 aspects are interrelated** to each other.
- For instance, language acquisition problem can be solved by making a language game, but **without support by psychology theories, the game will become boring** …..
- Also, the **knowledge of linguistic is important** too ….
- **STEM combines different aspects together to solve a particular problem** …..
- Therefore, **if we want to create a good game, all these 3 aspects cannot be omitted.**

Integrating the 3 disciplines Exemplar Student Product (1)

- Reflections on **personal gain**:

Student 2

- I am very grateful that I have **stepped out of my comfort zone** ….
- As a computer idiot, **I never thought I learn how to code, let alone make a game by myself** ….
- Credit to teachers' help and my perseverance, **I finally succeeded in turning my ideas into real products, which I never thought of** ….
- As long as we have perseverance, **there is nothing in the world that we can't learn, but only things we do not want to learn**.

Student 3

- **Before studying this course, I was afraid that I cannot fulfil the task,** as I am a **language major** student….
- **Successfully making and creating a game makes me feel so happy**, especially I have **faced a lot of difficulties and challenges in the process** ….

Where is the co-teaching?

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Co-teaching happens here

Co-teaching as Co-guiding

Co-guiding 1: Before proposal presentation

- Each student group has **an individual consultation** with **all 3 instructors simultaneously**, to share their initial ideas
- They receive suggestions from **3 perspectives**
- The 3 instructors also **build on and supplement the suggestions from one another**

Co-guiding 2: Proposal presentation

- All student groups present their proposals to **all 3 instructors and their classmates**, and receive constructive suggestions

Co-guiding 3: Working on project

- Student groups **consult different instructors** when they **integrate different disciplines** to their games

Co-guiding 4: Final project presentation

Co-assessing

GEI 4001 – STEM and its Application on Language Acquisition and Communication

Assessment Rubric for Assignment 1 - Project Proposal Presentation

	Outstanding	**Good**	**Satisfactory**	**Pass**	**Fail**
Significance of the identified problem ($CILO_2$)	Identifies a highly significant problem; well justifies the motivations	Identifies a significant problem; justifies the motivations	Identifies a valid problem; justifies only part of the problem	Identifies a valid problem; provides no justification	Identifies a non-valid problem; provides no justification
Interdisciplinary analyses in terms of language/ psychology/ STEM ($CILO_2$)	Uses interdisciplinary perspectives to analyze the motivations; shows an in-depth analysis in each discipline and a clear connection between disciplines	Uses multi-disciplinary perspectives to analyze the motivations; shows a good analysis in each discipline and attempts to connect disciplines	Uses multi-disciplinary perspectives to analyze the motivations; shows an analysis in each discipline but no connection between disciplines	Uses a single disciplinary perspective to analyze the motivations	Shows no analysis on the problem and motivations
Research on existing solutions ($CILO_2$)	A comprehensive review on existing solutions and their discrepancy in tackling the problem	A good review on existing solutions and their discrepancy in tackling the problem	A review on existing solutions	A review on existing solutions, not necessarily relevant to the problem	No review on existing solutions
Solution plan for problem solving ($CILO_1$)	Describes the solution plan in detail, with a strong relevance to tackle the problem	Describes the solution plan in detail, with a potential to tackle the problem	Describes the solution plan, with a potential to tackle part of the problem	Describes the solution plan with missing essential detail; relevance to the problem is not shown	The solution plan has no relevance to the problem
Creativity of the proposed solution ($CILO_1$)	Creative and well distinguished from existing solutions	Creative but share some similarities with existing solution	Resembles some existing solutions, but show clear differences	Modifies slightly from existing solutions	Identical to existing solutions
Presentation	Presents ideas with great lucidity and succinctness.	Presents ideas with reasonable clarity.	Presents ideas with limited soundness and clarity.	Presents ideas with very limited clarity or ambiguity.	Presents ideas poorly and ambiguously.

Co-assessing

- Individual rubrics are developed for each of the 3 assessments

1. Proposal presentation – All 3 instructors assess the proposal individually, but also **share suggestions to students in a common discussion**:

Bill										
Group no.	**Significance and motivations** of the identified problem (10)	Understanding and application of **design cycle (10)**	**Description** of the **making** and **evaluation** process (10)	Product **completeness** and **effectiveness (10)**	**Interdisciplinary analyses** of the product (10)	**Interdisciplinary reflection** on the process (10)	**Presentation (10)**	**Total mark (70)**	**Percentage**	**Comment**
Example	*6*	*6*	*7*	*8*	*7*	*7*	*7*	*48*	*68.57142857*	*The problem identified is important, but the grou*
	7.5	9	10	9	8	7	8.5	59	84.28571429	The project has conducted an evaluation of the pr
	8	7	7.5	7	8.5	8	8	54	77.14285714	The idea is interesting, though it is difficult to mat
	8	8	9.5	10	8	7	9	59.5	85	The product is finished to a high standard and cor
	9.5	7	8	8	8	9	9	58.5	83.57142857	The problem identified is important, and a good r

2. Final project presentation – All 3 instructors assess the final projects and products individually, but also share their suggestions to students in a common discussion

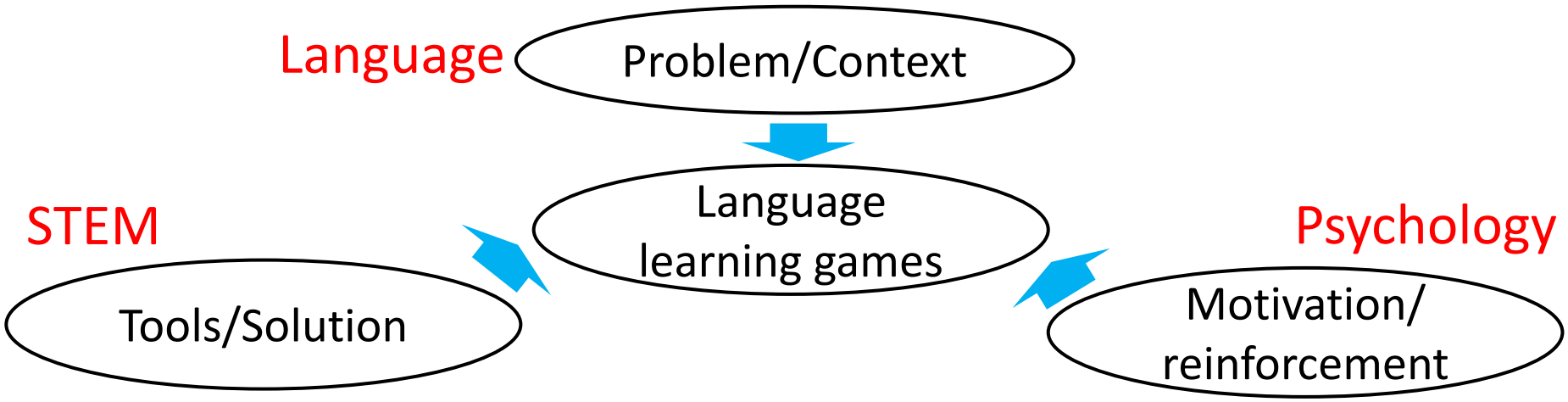
3. Reflective report – Being marked using the same rubric, with standardization after marking

Challenges

- Hands-on STEM in online course delivery – Due to the pandemic, most lessons are **conducted online**, which affect the STEM hands-on part of the course
- Students also reflected that they have difficulties working in **hands-on group projects online**
- Large workloads/efforts and a short time for product-making – most students reflected that they have spent **a great deal of efforts in making/improving their games**, some find it challenging, especially with a short time (3 weeks in Semester 1)
- Class size - **substantial guidance** to students is required for their integration of the 3 disciplines - a **large class size** may be more difficult to handle
- Criticism to students' ideas – **suggestions and criticism are important steps in STEM design cycles**, but some students may have negative feeling towards the criticism by lecturers

Summary

- Course design – **integration through product-making**:



- Most student groups **show interdisciplinarity in their products, and some perform much better than expectation**
- We found that **co-guiding** students on their **project development** is an important part of our co-teaching
- Challenges: hands-on STEM in online delivery, hands-on online group project, heavy workloads/efforts in product-making, large class size