Linguistics puzzles in the university curriculum

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Linguistics puzzles

A short history

- *Self-contained linguistics problems*[1] described by Zaliznyak (1963) as an alternative to classic reinforcing 'exercises'
- Original motivation: separating learners' understanding of concepts from their knowledge of the language of instruction, by giving them data they are not, and cannot be expected to be, familiar with
- Quickly gained popularity as outreach tool: *Linguistics Olympiads*
  - Moscow 1965–
  - Bulgaria 1982–
  - International Olympiad 2003–
  - UKLO 2009–, AILO 2009–, Isle of Man LO 2012–

[1] Also 'puzzles'; the original Russian *zadacha* can also mean 'exercise'

An example: Avestan numerals

Examine the words for various numerals in Avestan, the language of the scriptures of Zoroastrianism, the religion of ancient Iran. Some are given in Latin transliteration and some in the original script

Numeral	Avestan
6	xšvaš
8	ašta
17	haptadasa
7	𐬵𐬀𐬞𐬙𐬀
16	𐬑𐬱𐬬𐬀𐬱𐬛𐬀𐬯𐬀

What is the Avestan for 18? Write both the transliteration and the Avestan script.

Credit: Mikhail Gelfand [Moscow Linguistics Olympiad, 1981]

Problem-based learning

What is it?

> [f]ocused, experiential learning organized around the investigation, explanation, and resolution of meaningful problems (Hmelo-Silver 2004: p. 236)

- The PBL cycle

  - Problem scenario
  - Identification of the facts
  - Generation of hypotheses
  - Identification of knowledge deficiencies relative to the problem, via self-directed learning
  - Application of new knowledge
- Followed by abstraction → evaluation/reflection
- Solving a puzzle follows the same cycle

The educational goals of PBL

Problem-based learning helps students to

1. construct an extensive and flexible knowledge base;
2. develop effective problem-solving skills;
3. develop self-directed, lifelong learning skills;
4. become efficient collaborators;
5. become intrinsically motivated to learn

Puzzles aren't quite PBL, but close enough

- PBL problems are usually open-ended, highly complex and lacking a coherent structure (Hmelo-Silver 2004, Savery 2015)
- Some key differences
  - Puzzles do have a single 'right' answer (not open-ended)
  - We build an explicit progression from simple to complex
  - For pedagogical purposes, we can identify several types (structures), such as
    * 'Scramble' puzzles (matching of translations)
    * 'Rosetta' puzzles (translation to and from the target language)
    * 'Grid' puzzles (identification of internal structure)

Previous PBL experiences in linguistics

- Carstensen & Hess (2003): PBL-adjacent methods in computational linguistics, but not a full PBL package
- Filimonova (2020): closer to classic PBL, but uses applications rather than theoretical concepts directly

The Edinburgh experience

UG curriculum structure

- Pre-Honours (Year 1 & 2)
  - 1st year: 40 credits of Linguistics and English Language 1AB + 80 credits 'outside courses'

    - Diverse student body
    - Wide range of previous exposure
    - Wide range of motivations, from linguistics geeks to students taking a punt on a subject they'd never heard about
  - 2nd year: 40–80 credits of LEL2
- Honours (Year 3 & 4)
  - In-depth specialist courses
  - No obligatory curriculum, choice driven by motivation

Puzzles in LEL1A

- 'Circus' course covering a range of mostly structural topics
- 'Puzzle component' running alongside the lecture cycle
- Puzzles released weekly, solutions provided with a lag
- No explicit tracking of the lecture content
- Big chunk of final assessment

Why LEL1A?

- Self-contained problems: suitable for beginners
- Wide range of off-the-shelf puzzles at many levels of difficulty
- Lever to introduce a wider range of linguistic and cultural diversity early on
- Clear 'transferable skills', 'problem-solving' pitch

LEL1A puzzles: challenges

- Low metalinguistic awareness: even the simplest puzzles benefit from a knowledge of basic notions like 'tense', 'subject', which not all (especially UK) students have
- Lack of confidence, anxiety around assessment
- Students expect 'recipes', 'how to solve puzzles'
  - Clash with PBL ethos, expectations of 'productive failure'
  - Practical challenges in delivery
- Lack of obvious link to curriculum

Puzzles in LEL2D

- Second-year course: *Cross-Linguistic Variation: Limits and Theories*
- Covid-19: flipped pedagogy
- Pre-Covid 'lecture' → Covid-era asynchronous 'block' of puzzle followed by explainer video
  - Classic PBL structure
  - Technical content maintained unchanged, only the methods flipped

Progression and curriculum integration

- The simplest puzzles[2] do not require too much technical knowledge
- In 2D, we start from simpler puzzles like Manx {at the end of the handout), which are not much different, but do benefit from bringing some technical knowledge to bear
- They are on a continuum with fairly advanced puzzles (Alyutor at the end of the handout) that are not just complex but clearly build on the course content

[2] Such as those in 1A, or the Avestan above

LEL2D puzzles: challenges… and successes

- Negative feedback on workload, but hard to disentangle from Covid
  - In 2020/2021 we kept the basic model but made only one puzzle a week obligatory
  - This mostly resolved the workload complaints with no obvious downside
- Otherwise…
  - Good mastery of learning outcomes
  - Clear link to assessment
  - Positive feedback on curriculum structure

Long-term outcomes

- What we really want to know is if the puzzles have had a longer-term impact
- Survey sent out to five cohorts of LEL1A (≈ 1,500 students), although the earliest cohort was poorly represented
- 204 responses, all quantitative, some qualitative

Overall impressions

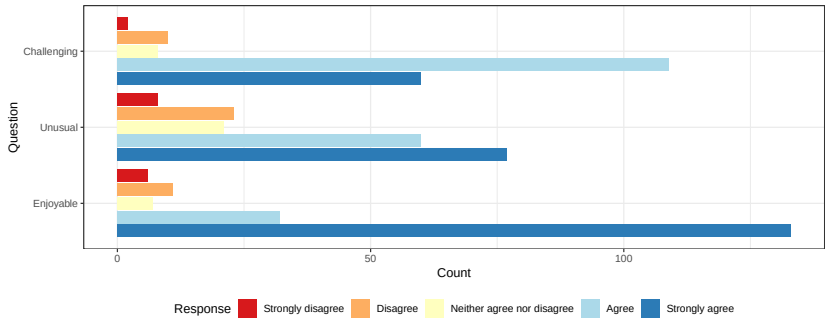

Figure 1: Responses to overall impression questions

- I found the puzzles challenging
- I found the puzzles unusual compared to what I had done before I did the course
- I found the puzzles an enjoyable part of the course

Local and longer-term effects

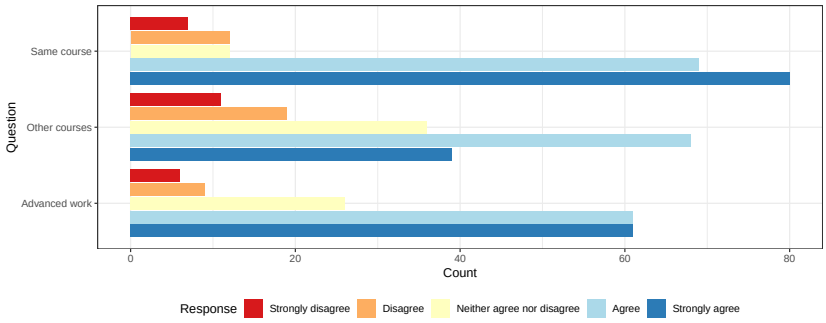

Figure 2: Responses to effectiveness questions

- The puzzles helped me understand the concepts we were learning about in LEL1A/LEL2D
- The puzzles helped me understand the concepts we were learning about in other courses
- The skills I acquired through doing the puzzles prepared me for more advanced work in linguistics

Learner needs

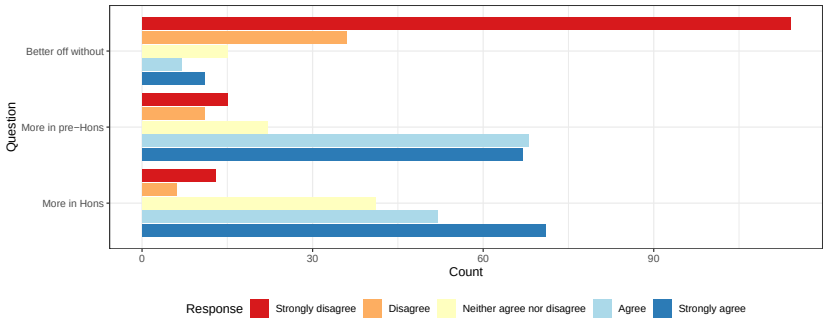

Figure 3: Responses to learner needs questions

- I would have liked LEL1A/LEL2D better if they did not have the puzzle component in them
- I would have liked to see more components like the LEL1A/LEL2D puzzles in other pre-Honours courses
- I would like to see more components like the LEL1A/LEL2D puzzles in LEL Honours courses

Qualitative feedback

- Overwhelmingly positive
  - Not all, admittedly

- Frequent references to general 'problem-solving' skills being useful, including from outside students

Did they help?

We asked learners how the skills taught by the puzzles were useful to them

> They were fun and gave me a lot more enthusiasm for linguistics, because it was the only context that we got to apply what we were learning practically.
>
> The puzzles require logical and out-of-the-box thinking, and as such I found them helpful in enhancing my overall thinking, as I found new ways to approach situations.
>
> I do philosophy, so it helped hone my logical intuitions.
>
> I remember finding them really tough… I think they were useful tools to consolidate learning each week. An unusual but fun addition to the course; although I really struggled with them.
>
> We had to dissect words/grammatical systems all the while trying to find patterns at a bigger scale, and this method of analysis has stuck with me throughout LEL1B, 2A and 2B so far. It's easier for me to analyse and notice motifs, no matter which topic the lecture is focused on. I also use this method in other courses and in everyday life.
>
> It was more about the method. It was very tempting to jump head first into the puzzle and figure it out intuitively, but obviously this was very inefficient and I had to learn to resist that impulse… The puzzles were by far the most interesting, challenging, and satisfying thing I have done at university! I wish more courses would adopt a similar approach to teaching!
>
> Not a linguistics student, but the way my understanding of language grew from these puzzles has been very helpful outside this field as well
>
> I am studying physics so the content of the puzzles hasn't been particularly useful but I have found the problem-solving aspect of them really useful to my degree. Particularly the skill of sitting with a problem and thinking about it from different angles has been useful

General feedback

> Easily the best part of the course/first year in general, extremely interesting and satisfying to work through
>
> I really enjoyed that the puzzles were a kind of practical example some of the theory we were learning. It also made it easier to learn some of the concepts after looking at examples from different languages and having to apply the theory myself. Getting to look at a lot of different languages was very interesting in general […]
>
> The puzzles were for me the most enjoyable part of both these courses. They are playful and make you want to study. I also liked to see that I was getting better at solving them with time […]

> Honestly I just thought they were really fun to do and they made us think outside the box - very useful for students just beginning linguistics, forcing us to not take for granted the way the languages we know work.
>
> The puzzles were probably my favourite part of my entire degree so far […] They are intellectually stimulating, challenging at the right degree, interesting and informative.
>
> They were great - I'd love to see them expanded into other courses, since the hands-on approach was both fun and very useful for educational purposes. Additionally, since many of the languages/dialects used came from the global south, I think they also help students to take a less Eurocentric view of the linguistics field as a whole.
>
> As hard as the puzzles could be, I think they've been a great way to introducing us to the work linguists do and are probably a better teaching method than readings. […]
>
> Above all, I think the puzzles were fun and a break from traditional-type of studying. This was especially welcome as a neurodivergent student who struggles with lengthy readings/lectures as it made it a very easy introduction to some of the important aspects of linguistics

The future: puzzles at Honours

- As well as embedded problem-based learning in the curriculum, linguistic puzzles also allow students to practise grammatical analysis
- In 2022/23, we are introducing an Honours course in designed to develop this skill
  - LEL1A: students practise solving puzzles;
  - LEL2D: students learn to relate puzzles to theory development;
  - Methods in Theoretical Linguistics: students learn to inform theory development, by making their own puzzles
- Much theoretical linguistics research involves using small-scale pieces of grammatical analysis to inform deeper theoretical debates
- NB! This is different from the common theme of many undergraduate/MSc research projects, which are essentially descriptive.
- We hope that Methods in Theoretical Linguistics can help students become adept at using the cycle of theory → prediction → empirical study → evaluation, at a relatively early career stage, building on their familiarity with the puzzles
- Watch this space…

Overall summary

- Puzzles follow many principles of problem-based learning
- They are pedagogically effective and have a motivating effect on learners
- This makes them suitable for use at earlier stages, where we cannot assume much technical knowledge, but their relevance continues into the more

advanced parts of the curriculum
- Caveats
  - Curricular integration
  - Teaching as guidance vs. teaching as recipe-giving
  - Workload

References

Carstensen, Kai-Uwe & Michael Hess. 2003. Problem-based web-based teaching in a computational linguistics curriculum. *www.linguistik-online.de* 17(5/2003).

Filimonova, Valentyna. 2020. Problem-based learning in introductory linguistics. *Language* 96(1). e1–e21.

Hmelo-Silver, Cindy E. 2004. Problem-based learning: What and how do students learn? *Educational Psychology Review* 16(3). 235–266.

Savery, John R. 2015. Overview of problem-based learning: Definitions and distinctions. In Andrew Walker, Heather Leary, Cindy E. Hmelo-Silver & Peggy A. Ertmer (eds.), *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows*, 5–15. West Lafayette: Purdue University Press.

Zaliznyak, Andreĭ Anatol'evich. 1963. Lingvisticheskie zadachi. In Tat'yana Nikolaevna Moloshnaya (ed.), *Issledovaniya po strukturnoĭ tipologii*, 137–159. Moscow: Izdatel'stvo Akademii Nauk SSSR.

LEL2D activity
Manx

Week 3, Block 8

Examine the following data from Manx, a Celtic language closely related to Irish and Scottish Gaelic. For this activity, you only need to understand the data and complete the translation exercises.

1.	*Ta yn shynnagh cloghey yn bluckan*	The fox chases the ball
2.	*Fillym yn tead*	I will fold the rope
3.	*Ta yn inneen dooney yn dorrys*	The girl closes the door
4.	*Ta yn kayt bwoalley yn bluckan*	The cat hits the ball
5.	*Ren eh giarey yn tead*	He cut the rope
6.	*Ta mee dooney yn uinnag*	I close the window
7.	*Doonym yn dorrys*	I will close the door
8.	*Loaghtee yn inneen yn eaddagh*	The girl will handle the cloth
9.	*Ren mee brishey yn uinnag*	I broke the window
10.	*Ren yn kayt filley yn eaddagh*	The cat folded the cloth
11.	*Doonee eh yn dorrys*	He will close the door

1. Translate into English

   (a) Ren eh cloghey yn kayt
   (b) Bwoallee yn tead eh
   (c) Brishym yn dorrys

2. Translate into Manx

   (a) The fox will cut me
   (b) The girl hit the ball
   (c) He closes the window
   (d) I handled the cat

LEL2D activity
Alyutor
Week 4, Block 2

For this activity, first examine the following sentences from Alyutor, a Chukotko-Kamchatkan language spoken in the Russian Far East, and complete the translations.[1]

[1] Some of you may remember your encounter with Alyutor in the first year!

1.	*ɣəmmə tajuk*	I came alive
2.	*ɣəmmə təleqtək*	I returned
3.	*muruwwi mətpiŋkulamək*	We jumped
4.	*muruwwi mətajulamək*	We came alive
5.	*ənnu məlavi*	He danced
6.	*ənnu leqti*	He returned
7.	*ətuwwi piŋkulat*	They jumped
8.	*ətuwwi ajulat*	They came alive
9.	*ətuwwi məlavlat*	They danced
10.	*ənŋin tatul piŋkuj*	This fox jumped
11.	*ənŋin ŋavʔan məlavi*	This wife danced
12.	*ənŋin milʲat leqti*	This hare returned
13.	*ŋanin qəlavul ŋətaj*	That husband arrived
14.	*ŋanin ʕurasik ivʔati*	That labourer swam
15.	*ɣəmnan takmitən ŋanin tatul*	I took that fox
16.	*ɣəmnan təlaʔun ənŋin ŋavʔan*	I saw this wife
17.	*ɣəmnan taŋjan ʕurasik*	I praised the labourer
18.	*ɣəmnan təmlan inʲat*	I broke the trap
19.	*ənannə kituʔənin ənŋin qəlavul*	He remembered this husband
20.	*ənannə laʔunin ŋanin kətɣəm*	He saw that sable[2]
21.	*ənannə jəvəklənin ənŋin kamak*	He hit this beetle
22.	*muryənan mətaŋjalan ənŋin əntəwəlpər*	We praised this son-in-law
23.	*muryənan mətkituʔəlan ŋanin niŋvit*	We remembered that devil
24.	*muryənan mətəmlalan ɣilɣil*	We broke the ice
25.	*ənŋinata tatulata laʔunin qəlavul*	This fox saw the husband
26.	*niŋvita aŋjanin ənŋin əniʲwiw*	The devil praised this uncle
27.	*ənŋinata ʕurasikita laʔunin tatul*	This labourer saw the fox
28.	*ŋavʔana kituʔənin ŋanin kamak*	The wife remembered that beetle
29.	*ənŋinata qəlavula jəvəklənin kalikal*	This husband hit the book
30.	*ŋaninata kətɣəma puntanin inʲat*	That sable attacked the trap

[2] A sable (*Martes zibellina*) is a species of marten widespread in northern Eurasia.

1. Translate into English

   (a) *muruwwi mətəmlavlamək*

   (b) ɣəmmə təpiŋkuk

   (c) muryənan mətaŋjalan ŋanin niŋvit

   (d) ənŋinata əntəwəlpəra mələnin ŋanin kalikal

2. Translate into Alyutor

   (a) They returned

(b) I swam

(c) This wife came alive

(d) I remembered that hare

(e) This sable saw the trap

Now consider alternative versions of some of the same sentences. They have the same meaning as their corresponding sentences from the first dataset, but use a different construction in Alyutor.

15a.	*ɣəmmə inakmitək ŋaninata tatulata*	I took that fox
16a.	*ɣəmmə inalaʔuk ənŋinata ŋavʔana*	I saw this wife
17a.	*ɣəmmə inaŋjak ʕurasikita*	I praised the labourer
18a.	*ɣəmmə inamlak inʲata*	I broke the trap
19a.	*ənnu inakituʔi ənŋinata qəlavula*	He remembered this husband
20a.	*ənnu inalaʔuj ŋaninata kətɣəma*	He saw that sable
21a.	*ənnu inajvəkli ənŋinata kamaka*	He hit this beetle
22a.	*muruwwi inaŋjalamək ənŋinata əntəwəlpəra*	We praised this son-in-law
23a.	*muruwwi inakituʔəlamək ŋaninata niŋvita*	We remembered that devil
24a.	*muruwwi inamlalamək ɣilɣila*	We broke the ice
25a.	*ənŋin tatul inalaʔuj qəlavula*	This fox saw the husband
26a.	*niŋvit inaŋjaj ənŋinata ənʲnʲiwa*	The devil praised this uncle
27a.	*ənŋin ʕurasik inalaʔuj tatulata*	This labourer saw the fox
28a.	*ŋavʔan inakituʔi ŋaninata kamaka*	The wife remembered that beetle
29a.	*ənŋin qəlavul inajvəkli kalikala*	This husband hit the book
30a.	*ŋanin kətɣəm inapuntaj inʲata*	That sable attacked the trap

How does the morphosyntax of the Alyutor construction exemplified in the second table differ from that shown in the first dataset? Translate the following sentences using the alternative construction:

1. I remembered that hare
2. We praised that uncle
3. This sable took the trap
4. The husband broke this devil

LEL2D activity
Alyutor
Week 4, Block 3

We continue working on Alyutor morphosyntax in this activity. Consider, again, the following clauses. Feel free to also refer to the data from the previous Alyutor activity to help you out.

1.	*ɣəmnan takmitən ŋanin tatul*	I took that fox
2.	*ɣəmnan təlaʔun ənŋin ŋavʔan*	I saw this wife
3.	*ɣəmnan taŋjan ʕurasik*	I praised the labourer
4.	*ɣəmnan təmlan inʲat*	I broke the trap
5.	*ənannə kituʔənin ənŋin qəlavul*	He remembered this husband
6.	*ənannə laʔunin ŋanin kətyəm*	He saw that sable
7.	*ənannə jəvəklənin ənŋin kamak*	He hit this beetle
8.	*muryənan mətaŋjalan ənŋin əntəwəlpər*	We praised this son-in-law
9.	*muryənan mətkituʔəlan ŋanin niŋvit*	We remembered that devil
10.	*muryənan mətəmlalan ɣilɣil*	We broke the ice
11.	*ənŋinata tatulata laʔunin qəlavul*	This fox saw the husband
12.	*niŋvita aŋjanin ənŋin ənʲnʲiw*	The devil praised this uncle
13.	*ənŋinata ʕurasikita laʔunin tatul*	This labourer saw the fox
14.	*ŋavʔana kituʔənin ŋanin kamak*	The wife remembered that beetle
15.	*ənŋinata qəlavula jəvəklənin kalikal*	This husband hit the book
16.	*ŋaninata kətyəma puntanin inʲat*	That sable attacked the trap

Now consider yet another set of alternative versions of some of these sentences (or very similar ones). We will discuss the precise differences in meaning in the lecture; for now, we will use the English definiteness as a proxy for the difference. You will note that there are some phonological changes going on in addition to some morphosyntactic action. Try to figure them on a descriptive level, as you would in a LEL1A puzzle — you do not need to provide any kind of analysis for them now, but we will come back to them in the phonology block.

1a.	*ɣəmmə tatulakmitək*	I took a fox
2a.	*ɣəmmə təŋavʔanlaʔuk*	I saw a wife
3a.	*ɣəmmə təʕurasikaŋjak*	I praised a labourer
4a.	*ɣəmmə tinʲatəmlak*	I broke a trap
5a.	*ənnu qəlavulkituʔi*	He remembered a husband
6a.	*ənnu kətyəmlaʔuj*	He saw a sable
7a.	*ənnu kamakivəkli*	He hit a beetle
8a.	*muruwwi mətəntəwəlpəraŋjalamək*	We praised a son-in-law
9a.	*muruwwi mənniŋvitkituʔəlamək*	We remembered a devil
10a.	*muruwwi mətɣilɣiləmlalamək*	We broke some ice
11a.	*ənŋin tatul qəlavullaʔuj*	This fox saw a husband
12a.	*niŋvit ənʲnʲiwaŋjaj*	The devil praised an uncle
13a.	*ənŋin ʕurasik tatulalaʔuj*	This labourer saw a fox
14a.	*ŋavʔan kamakkituʔi*	The wife remembered a beetle
15a.	*ənŋin qəlavul kalikalivəkli*	This husband hit a book
16a.	*ŋanin kətyəm inʲatpuntaj*	That sable attacked a trap

How does the morphosyntax of the Alyutor construction exemplified in the second table differ from that shown in the first dataset? Translate the following sentences using the alternative construction:

1. I remembered a hare
2. We praised an uncle
3. This sable took a trap
4. The husband broke a devil