Developing teacher competencies for teaching evolution across the primary school curriculum. A design study of a pre-service teacher education module

Additional file 2: Data collection and assessment methods across implementations

Methods	**1st implementation**	**2nd implementation**
Observation notes	Observation notes	Observation notes
Initial reflections on teaching evolution in primary school	Poll during video conference (N=19)*,[1] ; Small group discussions (shared Google docs)	Moodle questionnaire (N=19)*,[1]
What is Evolution - reflection with mindmap	-	Small group discussions (shared Google slides)
Reflection on the video “Big Family - a fantastic journey into the past”	Discussion in Moodle-Forum	(Discussion in Moodle-Forum, no responses)
Discussion of variation in class	Small group discussions (Shared google doc)	
Discussion: emphasis on genetic inheritance	Shared notes on BigBlueButton	Small group discussions (shared Google docs)
History of life milestones estimates on 1 m timeline	Screen annotation tool (screen shot)*	Screen annotation tool (observation notes)
Estimates of number of ancestors that lived 600 years ago	Estimates entered in group chat, observation notes	
Polls regarding evolutionary trees	-	Zoom Polls (week 3 and week 9)*
Natural selection assessment item (from KAEVO2.0)	-	Small group discussions (shared Google docs)

Fitness assessment item (KAEVO2.0)	-	Small group discussions (shared Google docs)
Story about the natural selection of a trait	Moodle database entry (N=9)	Moodle glossary entry (N=4)
Hypotheses about the evolution of a human morphological trait	Small group discussions (shared Google docs)	
Reflection and poll about traits that are responsible for the “success” of our species	Poll in BigBlueButton	Poll in Zoom
Mid-semester module feedback	-	Moodle questionnaire (n=10)*
Reflection: What is Culture	Small group discussions (shared Google docs)	-
Cultural Evolution Analogy Table	Small group activity (shared Google docs)	-
Reflection: What does evolution have to do with social-emotional competencies	Class discussion and observation notes	
Reflection on concept of Emotions	Break-out and whole class discussion and observation notes	
Functions and causes of emotions	Small group activity (shared Google docs)	
Reflection on concept of mismatch	-	Small group discussions (shared Google Docs)
Examples of possible mismatch in humans	Small group discussions (shared Google Docs)	
Evolution and learning analogy map	Small group activity (shared Google docs)	-
Reflection about fairness		Small group discussions (shared Google Docs)
Reflection about cooperation in the project group	-	Portfolio assignment
Hypotheses about the domestication of cats and dogs	Small group activity (shared Google docs)	-
Lesson Plans*	Individual essay (N=17)	Group work (N=4)

Final reflection	Group discussions (shared Google docs)	Portfolio assignment*

* See additional file 3 for a summary of results.
[1]Some students dropped out after the beginning of the semester so the number is higher than 18.

Rubric for the assessment of lesson plans

adapted from Carpendale, J., & Hume, A. (2019). Investigating Practising Science Teachers' pPCK and ePCK Development as a Result of Collaborative CoRe Design. In A. Hume, R. Cooper, & A. Borowski (Eds.), *Repositioning Pedagogical Content Knowledge in Teachers' Knowledge for Teaching Science* (pp. 223–250). Springer. https://doi.org/10.1007/978-981-13-5898-2_10

Category	0	1	2	3
Theoretical foundation and citations	Concepts of evolution, existing research and approaches are not discussed or they were not quoted.	Concepts of evolution, existing research and approaches are hardly discussed or not sufficiently cited.	Some concepts of evolution, existing research and approaches are discussed and all have been correctly cited.	Concepts of evolution, existing research and approaches are thoroughly and sufficiently discussed and everything has been correctly cited.
Originality of the materials/ of the teaching unit, suitable use of media	Existing materials have largely been adopted unaltered and uncritically, and/or original material has not been cited (plagiarism).	Existing materials have been adopted and quoted with slight modifications.	Existing materials and methods were critically examined and creatively incorporated and quoted.	Creative and original orientation and design, if necessary with critical consideration of existing materials and approaches and their citation
Learning goals/objectives, reference to the curriculum	Learning objectives are not clearly formulated and do not relate to the curriculum or to the promotion of competencies.	Learning objectives are not clearly formulated or do not relate to the curriculum or to the promotion of competencies.	Learning objectives are clearly formulated, relate to the curriculum of a subject and/or to the promotion of competencies.	Learning objectives are clearly formulated, relate to the curriculum of several subjects and to the promotion of competencies.
Reference to student understanding and knowledge	The level of understanding, interests and/or previous knowledge of students of the target age group is not addressed and the content is not suitable for this age group.	The level of understanding, interests and/or previous knowledge of students of the target age group are hardly addressed and the content is not sufficiently geared towards this age group.	The level of understanding, interests and/or previous knowledge of students of the target age group are partly addressed. Content and methods could be designed to be more age-appropriate.	The level of understanding, interests and/or previous knowledge of students of the target age group are sufficiently and explicitly addressed and the content and methods are appropriate.

Teaching strategies, materials, sequencing	The lesson sequence and/or the materials and methods are confusing, unattractive and not sufficiently prepared for the achievement of the learning objectives.	The lesson sequence and/or the materials and methods are sometimes confusing or unattractive or not adequately prepared for the achievement of the learning objectives.	The lesson sequence and the materials and methods are mostly clearly structured, appealing and largely allow achievement of the learning objectives.	The lesson sequence and the materials and methods are very clearly structured, very attractive and allow achievement of the learning objectives.
Evaluation methods	No possibilities are described how the achievement of the learning objectives can be assessed or how what has been learned can be consolidated.	One way of assessing the learning objectives or consolidating what has been learned is described, or the methods are inappropriate.	Some suitable ways of assessing learning objectives, reflecting, and consolidating what has been learned are described.	Several suitable ways of assessing learning objectives, reflecting, and consolidating what has been learned are described.