

A free-form assignment instead of an exam to stimulate students' motivation and retention of botany knowledge

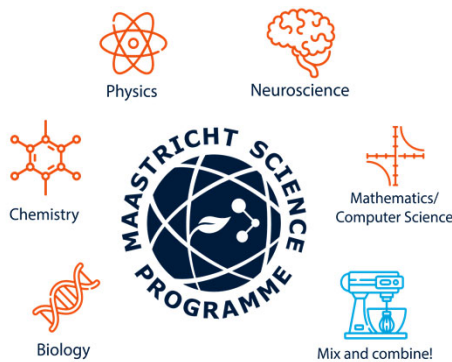
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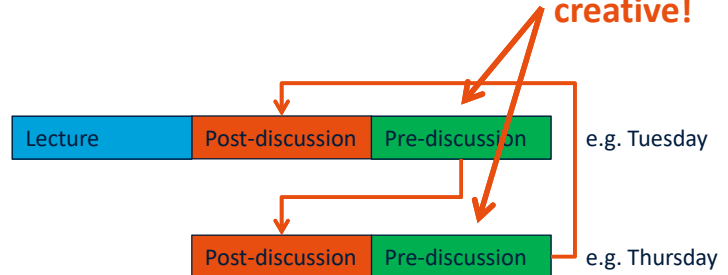


LAS foundation, natural sciences and P/RBL



- 8 week modules
 - 6 weeks content
 - 1 exam week
 - 1 reflection week
 - Each block min. two assessments

Be active and creative!



Dolmans et al. (2005). Problem-based learning: future challenges for educational practice and research. *Medical Education*, 39(7), 732-741. <https://doi.org/10.1111/j.1365-2929.2005.02205.x>

PBL sessions



Why keep mid-terms and exams traditional??

Sat exams are common

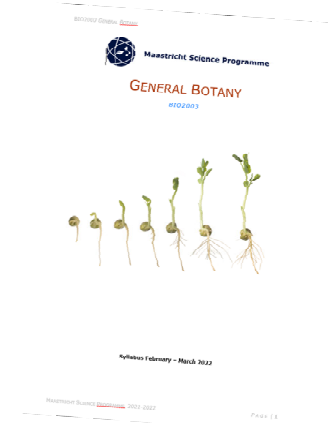
- Unwanted effects:
 - Cramming
 - Low retention
 - External driver
 - Not motivating
- Snap-shot test method



<https://library.maastrichtuniversity.nl/study/digital-exams/>

BIO2003 General botany

- Aims of redesign
 - 1) intrinsically motivate students to learn botany
 - 2) cover all topics of a traditional botany class
 - 3) reach high(er) level of understanding of these topics
- Design based on :
 - Adult Learning Theory (ALT; or “andragogy”)
 - Universal Design for Learning (UDL)
 - Contextual, Constructive, Collaborative, Self-directed (Uni Maas design principles)



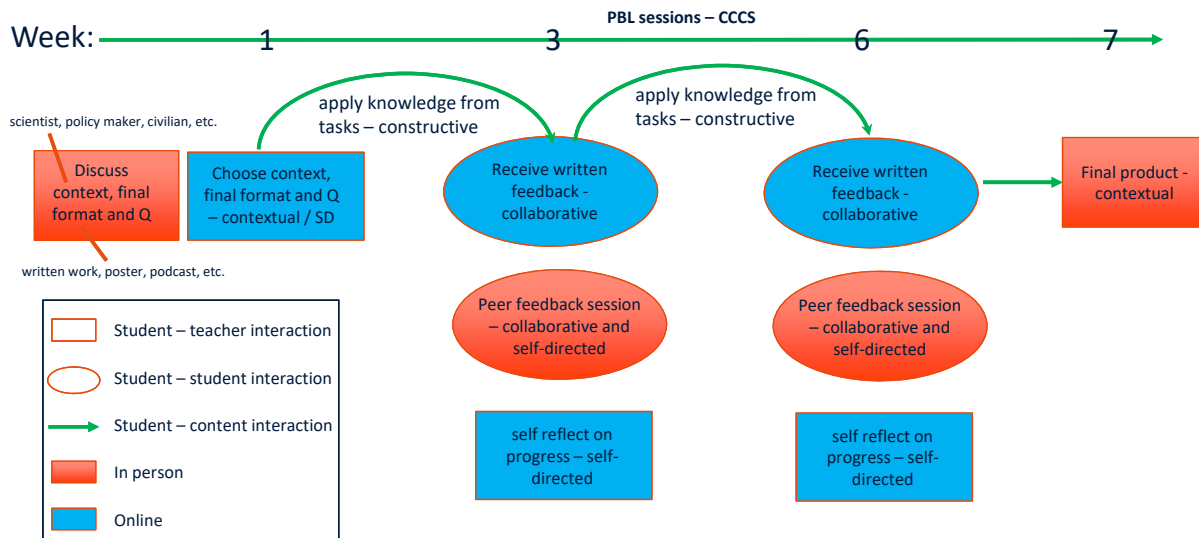
Green, M.L., & Ellis, P.J. (1997) Impact of an evidence-based medicine curriculum based on adult learning theory. *Journal of General Internal Medicine*, 12, 742-750. doi: 10.1046/j.1525-1497.1997.07159.x

Kleinke, S., & Lin, Y. (2020). Application of Adult Learning Theory to STEM Education in Online Learning Environment. Paper presented at the 2020 IEEE Frontiers in Education Conference (FIE).

Burgstahler, S., & Cory, R. (2008). *Universal design in higher education: From principles to practice*. Cambridge, MA: Harvard Education Press.

Rose, et al. (2006). Universal design for learning in postsecondary education: Reflections on principles and their applications. *Journal of Postsecondary Education and Disability*, 19(2), 135-151.

Assignment organization



Examples of works

Introduction
Rice (*Oryza sativa*) is a monocot angiosperm and belongs to the grass family Poaceae. It is one of the world's most important food crops, providing 20% of the global population's energy supply (FAO, 2004). Its cultivation distribution ranges from Asia, Africa, Europe, and the Americas. It is a very water intensive plant, being classified as semi-aquatic, as it frequently grows in flooded paddies which enable sufficient water availability and reduce pest growth. Its water use makes rice especially susceptible to drought. Globally, it is predicted that extreme weather patterns will continue to increase, and especially drought may threaten global crop production. Developing countries, who may lack the financial and technological means to manage crops will be affected by this the most, possibly resulting in food shortages (Miyaz, 2015). Therefore, it is of importance to study this plant's morphogenic changes in response to drought. From this, approaches for genetic modification can be developed which would produce new rice variants with increased drought resistance, thereby providing global food stability. This literature review summarizes the effects of drought on rice, as well as insights into experimental methods employed to genetically modify this plant to increase its drought resistance.

Main
Hormones and plant communication
Under normal conditions, rice growth and seed production are regulated by a complex interaction of the hormones auxins, cytokinins, gibberellin and ethylene. These are produced mainly in the roots, but also in developing shoots (e.g. awns), and are transported throughout the plant via the vascular system, as short distance symplastic or apoplastic transport (Mauseth, 2016). Because of the variety in receptors present in cells, tissues differentially respond to hormones.
Drought is signalled within the plant via the hormone abscisic acid (ABA), which is produced in the roots in response to various environmental stimuli. In plant science, drought is defined by a water deficit, caused by a rate of transpiration greater than the rate of water uptake (Martyrjaga et al., 2020). The first place where it is felt by the plant is in the roots, as water is pulled into the xylem, but no water from the soil is available. As a result of the negative pressure potential in the xylem, water diffuses out of the root cells, causing them to dehydrate. This triggers a transcriptional mechanism which leads to the production of ABA, which is released into the xylem, where it is transported throughout the plant (Kumar et al., 2022). ABA binds to its cell-membrane receptors with sufficient concentration to overcome their threshold level, it overrules normal activity, inducing morphogenic responses favouring water conservation, among others. The variety of ABA-induced responses is related to the variety of ABA receptors, a large family of proteins, of which different types exist depending on the location in the plant (Miao et al., 2018). It has been found that mutants of these receptors exhibit more sensitive, i.e. have a lower threshold level, could increase drought tolerance, because water-conserving mechanisms would be induced earlier. Furthermore, they can change the balance of different drought stress

Grade distribution

2013-2019: regular midterm and exam
 2020: exam + review session (COVID)
 2021-2022: free form assignment

	2013	2014	2015	2016-I	2016-II	2019	2020	2021	2022
Average*:	5.84	6.58	6.84	7.17	7.36	7.12	6.51	7.57	7.95
St. dev.:	1.80	1.28	0.86	0.62	1.28	0.83	0.75	1.11	0.89
Above 5.5:	12	8	17	14	13	12	28	39	51
Pass % :	60.00	72.73	100.00	100.00	92.86	100.00	93.33	97.50	100.00

*Grades are given between 1-10 in the Dutch system, 10 being excellent, < 5.5 is a failing grade

Student evaluation

N=29 out of 51

The assignments (self-assessments, peer review, final product) facilitated my learning	➔	>70% agrees
The peer review sessions were valuable to me		>70% agrees
The free choice for the final assignment (context, case and format) was valuable to me		>80% agrees
In this course, I have been challenged to learn more than I expected		> 65% agrees
I was more prepared for tutorials than in other courses		> 70% agrees
I have put a great deal of effort into advancing my learning in this course		100% agrees
The course workload was higher than for a class with an exam at the end	➔	True 45%, Neutral 38%, No 17%
I would like to have more classes with a free-form assignment		>65% agrees
This class has increased my interest in the field of botany		100% agrees
This course was challenging		59% yes
This course made me think		100% agrees
I believe that what I learned in this course is important and relevant for me	➔	>95% agrees

Pros and cons of free-form design



What parts of the course aided your learning the most?



What parts of the class were obstacles to your learning?

Student self-evaluations

1. Attitude towards studying

- "I should most definitely start on the self assessment quizzes to doublecheck that I actually understand the content of the course on my own and not just in a group" (week 3 SA)
- "I also think I improved my way of working, I procrastinated less for the tasks work and instead worked more regularly" (week 6 SA)

2. Performance in terms of content

- "After week 3 I feel I have learned more than ever, I can explain to my roommates about roots, life-cycles, secondary growth, etc.. Before I could not even understand the structure of a plant" (week 3 SA)
- "I focused a lot in my tutorials and always made sure I responded to all the learning goals correctly and with enough depth" (week 6 SA)

3. Overall progress

- "I would like to dedicate more time to this course because I'm really interested in the details of the subject, but I am enrolled in several extracurricular activities that take up a lot of time" (week 3 SA)
- "I have noticed that when I am walking around outside I can relate a lot of the plants back to what we are learning in class which is really cool." (week 6 SA)

Conclusions

- Were aims of redesign met?

- 1) intrinsically motivate students to learn botany

Hopefully yes, many positive responses in evaluation and SA

- 2) cover all topics of a traditional botany class

Definitely, no topics were take out of the class

- 3) reach high(er) level of understanding of these topics

Hopefully yes, good grades, students report outside of class application

Acknowledgements

Thanks to all students in my classes who work hard to get the most out of them and are happy to be my educational guinea pigs!



Answers to Q: "describe this 2022 botany class in one word"