E-learning design for higher skill acquisition in the undergraduate biomedical sciences

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Abstract

Scholar literature suggests that alignment between success factors in Instructional Design, Pedagogy and Technology are key to e-Learning efficacy. We applied those success factors in a backward design strategy to develop active-learning resources that comply with good practice in pedagogy. Five e-Learning activities that aim at higher skills (e.g. 'Apply', 'Analyze', and 'Evaluate' from Bloom's Taxonomy) were designed and served as frameworks to further implement up to 50 e-Learning activities in a large-size Biochemistry class.

Keywords: 'active learning', 'e-Learning', 'higher skills'

Introduction

As we adapt to implement e-Learning practices, it is key to also adapt courses to foster the acquisition of higher skills by students.

Lower-skill intensive (focus on memorization) → **Prioritizing higher skill acquisition** (*Apply*, *Analyze* and *Evaluate* from Bloom's Taxonomy)

Aim:

To create pedagogical material enabling biomedical science students to develop higher skills while learning course material.

Goals:

1. Identify the most important scholarly parameters contributing to well-designed e-Learning material.
2. Design five useful e-Learning activities fostering higher skills that are adapted for BIOC311 course content.

Methods

Step 1: Identification of success factors

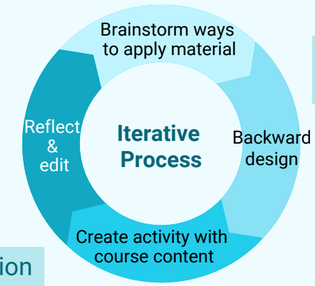
Factors to optimize e-Learning in students vary with context; no comprehensive model exists.

Literature search of recent peer-reviewed articles identified 10 most common and relevant factors; divided them into three categories (Table I).

Table I. Relevant Factors Contributing to Successful e-Learning

Category	Factor
Instructional Design	Student-centeredness
	Perceived usefulness
	Clear instructions
	Varied material
Pedagogy	Adequate conditions
	Interactivity
	Fair assessment
	Coherent alignment
Technology	Proper IT infrastructure
	Available technical support

Steps 2 & 3:



Activity Design

Metacognition

Results

*my*Courses

Five activities, including learning outcomes, instructions, rubrics, & grading instructions:

1. Answering a student email *(APPLY, EVALUATE)*
2. Creating concept maps *(APPLY, EVALUATE)*
3. Applying knowledge to another context *(APPLY, ANALYZE)*
4. Refuting pseudo-science claims *(APPLY, EVALUATE)*
5. Audience-dependent scientific communication *(ANALYZE, EVALUATE)*

Interaction: between students (collaboration) & with graders (feedback).

Learning concepts while developing key skills (e.g. adaptability, teamwork, communication, critical thinking, problem-solving, and professionalism).

Retroactive assessment: all activities met 9/10 of identified parameters ('Adequate Learning Conditions' cannot be evaluated in isolation).

Conclusion

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Activities implemented in BIOC311, serving as models for TAs to develop 50+ sample problems. Contributed to course redesign (memorization → higher skill acquisition). Can also be adapted to other disciplines by applying identified success factors.

Limitations:

- Lack of testing: do activities truly help students gain higher skills throughout the course?
- Class average improvement from Fall 2019 to Fall 2020 could be due to other factors (e.g. remote delivery, different student cohort, instructor change, etc.).
- Learning curve (no rapid results post-implementation) & student pushback.

Avenues for Future Work:

- Creating diagnostic tests to be conducted at start and end of course. *Are activities useful?*
- Studying which parameter(s) benefit student learning in undergraduate biomedical science courses to develop a reliable model (Higher skill acquisition through e-Learning).

References

Alsabawy, A. Y., Cater-Steel, A., & Soar, J. (2016). Determinants of perceived usefulness of e-learning systems. *Computers in Human Behavior, 64*, 843–858.https://doi.org/10.1016/j.chb.2016.07.065

King, E., & Boyatt, R. (2015). Exploring factors that influence adoption of e-Learning within higher education. *British Journal of Education Technology, 46*(6), 1272-1280. https://doi.org/10.1111/bjet.12195

Kuo, Y.-C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *The Internet and Higher Education, 20*, 35–50. https://doi.org/10.1016/j.iheduc.2013.10.001

Leacock, T. L., & Nesbit, J. C. (2007). A framework for evaluating the quality of multimedia learning resources. *Educational Technology & Society, 10*(2), 44–59.

Masoumi, D., & Lindström B. (2012). Quality in e-Learning: A framework for promoting and assuring quality in virtual institutions. *Journal of Computer Assisted Learning, 28*(1), 27– 41. https://doi.org/10.1111/j.1365-2729.2011.00440.x

Penny, K. (2011). Factors that influence student e-Learning participation in a UK higher education institution. *Interdisciplinary Journal of E-Learning and Learning Objects, 7*(1), 81-95.

Packham, G., Jones, P., Miller, C., & Thomas, B. (2004). E-learning and retention: Key factors influencing student withdrawal. *Education Training, 46*(6-7), 335–342.

Sun, P.-C., Tsai, R. J., Finger, G., Chen, Y.-Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education, 50*(4), 1183–1202.

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