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STUDENT'S PERCEPTION AND LEARNING OUTCOMES WHEN USING AN ELEARNING-SCENARIO

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Abstract: *The present study analyses 10th graders' perceptions of eLearning by examining a student's rating of an eLearning scenario and their cognitive load while working on a web-based module. Additionally, we focus on learning outcomes monitored by a pre- and post-test questionnaire as well as by digital workbooks. Additionally, the completion of an eLearning task triggering critical thinking was taken into account. Summarizing first analyses, data points to a positive perception of an eLearning scenario, a cognitive achievement effect as well to a support of critical thinking.*

Keywords: *eLearning; student's perception; learning outcome; rainforest; climate change*

1. INTRODUCTION

eLearning is regarded as a "new learning paradigm" [1], [2] and consequently enters more and more today's education. These circumstances are reflected in the Digital Agenda for Europe, where especially Action 68 requests to "mainstream eLearning in national curricular for the modernisation of education". Consequently, requirements for digital literacy of educators and students lead to the establishment of initiatives like the Open Discovery Space Project (ODS). The main objective of ODS is to introduce changes in educational practices and develop resource-based learning. As a starting point, pedagogical best practice scenarios were developed and uploaded to a digital access point: the ODS portal. The evaluation of ODS mainly addresses teachers through the monitoring of their actions on the portal and the implementation of questionnaires paired with more qualitative direct evaluation through workshops, interviews and focus groups [3].

Nevertheless, students need consideration as actual end-user whom should profit the most by the integration of new learning methods. Thus, it is important to examine how students are affected by eLearning which should promote critical thinking and prepare them for the labour market [4]. However, Manochehr [5] complains about a lack of documentation for eLearning as an "effective delivery mechanism" regarding for instance learning outcomes.
Up to now, some statements exist concerning students' perception of eLearning and the related learning outcomes: Morgil et al. [6] found students as pre-set to acquire knowledge „through the teacher" and consequently as hesitant to use computer assisted educational applications; nevertheless, this perception changed after participating in an eLearning class. Cox [7] reported students' attitudes being dependent "upon their overall experience of using e-learning".

Our present study focuses on the first results of the implementation of a learning scenario of the ODS portal: Tropical Rainforest and Climate Change. Herein, we present the cognitive achievements, the rating of student's in regard to their cognitive load (CL) and perception of usefulness.

2. MATERIAL AND METHODS

114 tenth graders (age 16.51; SD 1.459; 50.88% male, 49.12% female) participated in an 1.5 hour learning programme dealing with tropical rainforest and climate change. Student's followed the learning scenario available on the ODS portal and worked with the learning resource "Bayreuth goes Ecuador" which is a website compromising several applications like a video, texts, an interactive animation, a carbon footprint calculator and an analysing tool to examine two original datasets of a DFG group recorded in Ecuador. Students are guided through these activities by dividing the unit in three different tasks including five leading questions each which they directly answer on the website (and sent themselves via email) or in a digital workbook.

In order to analyse perceptions on this learning scenario, the participants were asked to rate how appealing they found the three different tasks according to school grades ranging from 1 "pleased me very much" to 6 "pleased me not at all". Additionally, we asked students to state their CL) varying between 1 very small CL and 9 very high CL with 5 as an anchor point defined as the CL of an everyday class. 82 students provided their opinion on these variables. Measuring the learning outcomes is based on a pre-, post-test design (Figure 1, retention test not available yet). All tests contained 30 questions dealing with tropical rainforests and climate change, which were covered by the eLearning programme and a previous preparing hands-on circle. All 114 students answered the questionnaire.

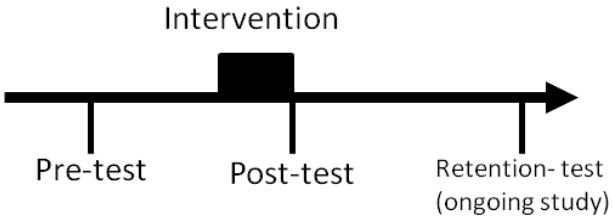

Figure 1: Study design

Furthermore, the digital workbooks of these 114 students were analysed regarding two exemplary tasks. Task A contains the shading of tropical rainforest regions on a map (example provided in Figure 2) while task B focussed on the analysis of original data and asked students to draw their own conclusions concerning the existence of a temperature trend, it's causes and its consequences. The latter task was analysed according to Mayring's qualitative content analysis [8], whereas statistical analysis was performed using SPSS Version 22 [9].

3. RESULTS

In general, students rated all three tasks within the fair ranges (means between 2.46 to 2.74) although some of them required the total spectrum for feed back. This is reflected by written comments (in the digital workbooks) like "It was interesting and was fun." (male student, age 14), "...all [other] tasks were ok" (male student, age 15), "really helpful, recommendable" (male student, age 16). Some students stated the tasks were "complex to handle..." (female student, age 17) which points to a CL situation. Herein, the complete range was needed in order to rate the tasks. Generally, students rated all tasks below the CL of a usual lesson in their classes. All measurements are detailed in Table 1.

Table 1: Students' perception of eLearning tasks

task	Mean	SD	mini-mum	maxi-mum	Percentile		
					25.	50.	75.
Grades							
T1	2,46	,840	1	6	2,0	2,0	3,0
T2	2,74	,894	1	5	2,0	3,0	3,0
T3	2,56	1,002	1	6	2,0	2,0	3,0
cognitive load							
T1	3,52	1,701	1	9	2,0	3,0	5,0
T2	4,04	1,810	1	8	2,5	4,0	5,0
T3	3,52	1,513	1	8	2,0	3,0	5,0

Using Kolmogorow Smirnow depicts all variables (age, grades, CL and gender) as not normal distributed by a significant p-value < 0.001. Consequently, non-parametric analyses were used for examining further interrelations. There is no connection between gender and the perception of the eLearning programme (neither grades nor CL), which is supported by a non-significant Mann-Witney U and Wilcoxon Test using gender as grouping variable (Table 2).

A positive correlation exists between the provided grades and the CL of each task (marked bold in Table 3). Furthermore, CL correlates positively between the different tasks and additionally the grade of the first task correlates positively with the second and third task (table 3).

Table 2: Gender equality

	T1_grade	T2_grade	T3_grade
Mann-Whitney-U-Test	768.500	702.000	719.500
Wilcoxon-W	1363.500	1297.000	1895.500
U	-,483	-1,131	-,983
Asymp. Sig. (2-tailed)	.629	.258	.326
	T1_CL	T2_CL	T3_CL
Mann-Whitney-U-Test	794.500	657.500	763.5
Wilcoxon-W	1970.500	1833.500	1939.500
U	-.206	-1.511	-.502
Asymp. Sig. (2-tailed)	.837	.131	.616

In regard to student's learning outcomes, all 30 items showed a Cronbach's alpha of 0.769 and thus can be used reliably. Students generally improved their knowledge by using the eLearning resource. The maximal knowledge increase constitutes 11 items whereas the mean is 3.16 items with a standard deviation of 2.45 items. No gender effect is present according to a non-significant (p=0.118) Man Whitney U (U=-1.562) and Wilcoxon (W=3062.5) test. No significant correlation between age and knowledge gain are present (Spearman Rho=-0.114; p=0.229). Concerning Task A, 4.17 correct regions (SD=2.04) were averagely shaded in the pre-test. After participating in the scenario students correctly shaded almost two new regions during the post-test (mean 1.96 SD 1.828) depicting a significant (p<0,001) knowledge increase.

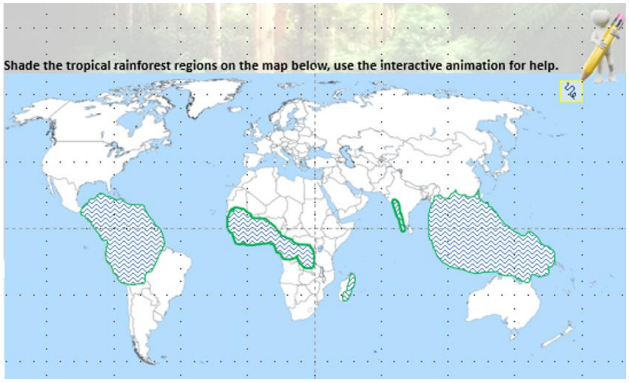

Figure 2: Shading tropical rainforest regions

Table 3: Spearman Correlations

		Age	T1_ grade	T1_CL	T2_ grade	T2_CL	T3_ grade	T3_CL
Age	R	1.000	.034	-.088	-.053	.052	-.006	-.035
	Sig.		.762	.434	.638	.642	.960	.753
T1_grade	R		1.000	**.272***	.414**	-.028	.240*	.020
	Sig.			.013	.000	.800	.030	.858
T1_CL	R			1.000	.090	.361**	.054	.495**
	Sig.				.423	.001	.631	.000
T2_grade	R				1.000	**.228***	.211	.136
	Sig.					.039	.057	.222
T2_CL	R					1.000	.114	.345**
	Sig.						.308	.001
T3_grade	R						1.000	**.367****
	Sig.							.001
T3_CL	R							1.000
	Sig.							

* Correlation significant (two-tailed) at 0.05 level.

**Correlation significant (two-tailed) at 0.01 level.

The majority of students correctly recognized a raising temperature trend in the DFG data of task B, whereas only 7% did not report a trend. Additionally, some students assessed the quality of this temperature increase. Hereby, 4% regarded the increase as huge over time, while 6% stated the increase as very small (shown in Figure **FIGURE 3**). While reflecting on the reasons for this temperature trend, students provided four concepts: global climate change, the anthropogenic greenhouse effect, human land use and generally the loss of the tropical CO_2-repository. Hereby the general global reasons climate change and greenhouse effect were dominant as shown in Figure 4**Error! Reference source not found.**. A similar proportion can be found by examining the consequences which students indicated. Here as well global consequences like "melting of poles", "changing of seasons" or "sea level rise" were mentioned often although students were explicitly asked to describe consequences for the tropical rainforest ecosystem. The distribution of consequences is shown in Figure 5. About 50% of the students focussed on the actual task and described consequences for the tropical ecosystem.

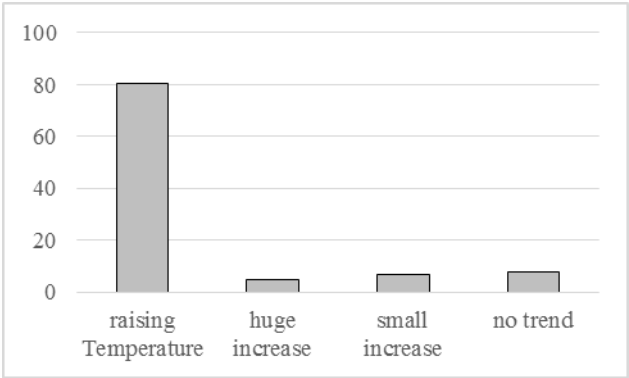

Figure 3: Students' statement on temperature trends

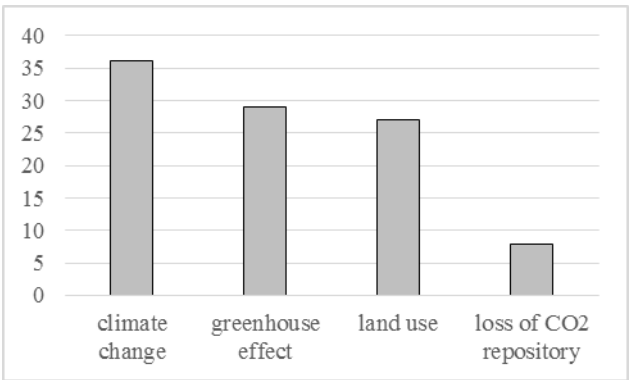

Figure 4: Reasons for temperature increase

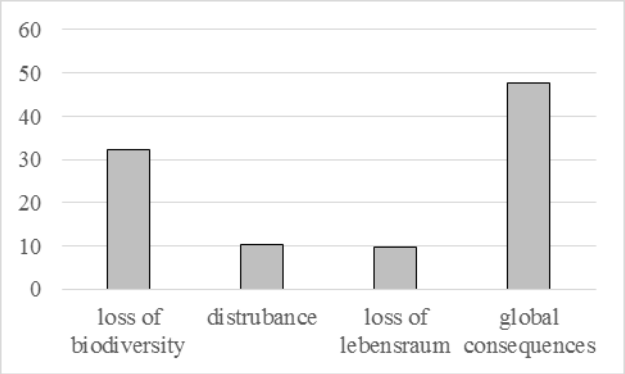

Figure 5: Consequences in tropical rainforest ecosystem

More than half of these students depicted the loss of biodiversity whereas the disturbance of the ecosystem including all connected biological consequences (adaptation, migration, speciation and extinction) and the loss of lebensraum (mainly for animals) were described by each 10%.

4. DISCUSSION

In our present study, a general positive perception for an implemented eLearning scenario was found. This possibly resembles student's familiarity and comfort with modern pedagogical practice. Already at home technology seems to be a matter of course as 85% of German households own a personal computer and 93% of youths (16-24 years) use the internet daily[1].

However, not all students rated the tasks as pleasant reflected through the utilisation of the complete spectrum of grades. This different perception of students is in line with Cox [7] who described students' attitudes being related with their prior experiences which are individual and thus probably different within our sample. Although in our very first case study, we could not collect data about computer skills the ongoing study will tackle this issue soon. When examining the interrelations of task grades a significant correlation between the first task and the rating of the subsequent tasks was found. This could be interpreted as a loss of motivation. If students did not like the first task (high = bad mark), they did not like the others either. This might reflect a general problem with the learning method as described below. Sun et al. [2] found seven variables as determining an eLearners' satisfaction namely "learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessment". Consequently, these aspects need to be taken into account for the ongoing study. Another crucial factor is the correlation between student's rating and CL. Although CL was stated to be below a typical classroom experience, we found a positive correlation between CL and grade. As in the German school rating system a high grade reflects a bad mark we find students perceiving the task as difficult are rating it badly. Furthermore, the correlation context pinpoints a relation between the CL of the first and other tasks. If students had difficulties with the first task, they are expected to encounter difficulties with the other tasks as well. This needs consideration as a general difficulty with the learning object and thus the media internet and digital workbook. As the webpage contains a variety of interactive information sources, these findings are in accordance with Van Merriënboer and Ayres [10] who concluded "element interactivity [...] may be too high to allow for efficient learning. However, other factors like learning styles should be taken into account as well. Manochehr [5] found eLearning to be more effective for particular learning styles than for others. In his study students following the "Assimilator and Converger" learning style performed better and thus reached a higher knowledge increase than the other students. In our study, all students could achieve a knowledge increase both in the pre and post-test knowledge questionnaire and in the development of shading tropical rainforest regions. Herein, we could not find any relation, neither between gender nor age, suggesting our eLearning programme to be efficient for the complete target group. Knowledge increase through the implementation of an eLearning module was already found by other authors [6], [11] even leading to the statement "Online e-Learning is an alternative to traditional face-to-face education" [2]. However, this conclusion should not be drawn too quickly and is not yet broadly agreed on. Clark [12] explained it is "not the medium that causes learning. Rather it is the design of the lesson itself and the best use of instructional methods that make the difference". Consequently, further studies are needed to find a broader consensus on this issue.

Regarding the students' competencies within our eLearning scenario, a majority was capable to correctly interpret a plot of more than 40.000 data points. Nevertheless, the answers mostly followed a media-influenced pattern tending to blame global climate change as the ultimate reason. Although a smaller portion of our sample reflected more in detail and, when stating the greenhouse effect as a reason, clearly emphasised its anthropogenic origin. Additionally, the concept of land use included statements like "tropical rainforests get deforested for palm oil plantations (for our daily consume goods) which leads to an increased carbon dioxide emission and thus an increased greenhouse effect" (female student aged 17). These observations are congruent with the question on consequences. Although specially asked to report on consequences affecting the tropical rainforest ecosystem, the vast majority named global consequences like in the following example: "The consequences of the raising temperature are rising sea levels and melting glaciers." (male student, aged 17). Here as well students with a focus on the actual task provided more elaborated statements on the loss of biodiversity "which we did not even discovered completely and might withhold important medical plants or interesting animals" (female aged 18). Statements like these might originate from a general interest on

[1] Number provided by the federal statistical office

environment or from a preparation lesson within the botanical garden. The loss of lebensraum which was mainly stated in regard to animals depicts a classical phenomenon named "zoochauvinism" [13]. Students generally neglect plants as living organisms as a result of education in which plants are seldom used as examples and their daily perception of plants that are not moving and do not show the signs of living on a quick glimpse. As students did not necessarily encounter plants in the eLearning module, it is not remarkable to find this common pattern. Interestingly students who pinpointed the disturbance of the ecosystem included all possible biological consequences and thus did not evaluate the temperature development as something bad but more as an ongoing process which conveys evolutionary trade-offs. This interpretation might result from prior class teaching as ecology and thus adaptation and speciation are topics of the 10^{th} grade curriculum. Certainly, it is interesting to see students connecting an already existing prior knowledge throughout our eLearning scenario. These findings are in line with [4] and [11] as both studies emphasize eLearning to promote critical thinking and the ability to apply learning.

5. CONCLUSION

A successful implementation of any eLearning scenario needs reflection by significant learning outcomes and activation of critical thinking. Our study points into this direction. Furthermore, in our study students generally perceived an eLearning scenario as a good learning environment in which they could accomplish successful learning outcomes. Although our study is just one single showcase, as other studies also point to successful learning achievements we tend to conclude that eLearning offers a good opportunity to pass on knowledge to today's youth. Nevertheless, in a broader context other variables such as learning styles and design improvements should be taken into account to further improve this way of learning and students perception.

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LITERATURE

[1] Yacob, A., Kadir, A. Z. A., Zainudin, O., & Zurairah, A. (2012). *Student Awareness Towards E-Learning In Education.* Procedia-Social and Behavioral Sciences, **67**, 93-101.

[2] 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.

[3] Bissinger K., Arnold C.J. (2014): D5.2-2 *The Revised Evaluation Plan*. Open Discovery Space.

[5]Manochehr, N. N. (2006). *The influence of learning styles on learners in e-learning environments: An empirical study.* Computers in Higher Education Economics Review, **18(1)**, 10-14.

[6] Morgil İ, Arda S., Seçken N., Yavuz S. &Özyalçin Oskay Ö. (2004); *The Influence of Computer-Assisted Education on Environmental Knowledge and Environmental Awareness*; Chemistry Education: Research and Practice, Vol.**5; No2. 2**; pp. 99-110

[7]
Cox, M. J. (2013). Formal to informal learning with IT: research challenges and issues for e-learning. *Journal of Computer Assisted Learning*, *29*(1), 85-105.

[8] Mayring, P. (2004). Qualitative content analysis. *A companion to qualitative research*, 266-269.

[9] IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

[10] Van Merriënboer, J. J., & Ayres, P. (2005). *Research on cognitive load theory and its design implications for e-learning.* Educational Technology Research and Development, 53(3), 5-13.

[11] Cradler, R., & Cradler, J., (1999) *Just in Time: Technology Innovation Challenge Grant Year 2 Evaluation Report for Blackfoot School District No. 55 San Mateo*; CA: Educational Support Systems

[12] Clark, R. (2002). *Six principles of effective e-learning: What works and why.* The E-Learning Developer's Journal, 1-10.

[13] Bozniak, E.C. (1994). *Challenges facing plant biology teaching programs*. Plant Science Bulletin, **40**, 42–26

[4] Cradler, J., McNabb, M., Freeman, M., & Burchett, R. (2002). *How does technology influence student learning?*. Learning and Leading with Technology, **29(8)**, 46-49.