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Self-regulated learning: comparing online and classroom courses in cognition, metacognition, motivation, emotions, contexts, and behavior.

Abstract

This research aims at evaluating the use of cognition, metacognition, motivational, emotional, contextual and behavioral processes in self-regulated learning in online and traditional classroom environments for two separate experiments with two groups each. We used a questionnaire developed based on the adaptation of six existing scales, with the addition of a general section about the course itself. By contrasting the two experiments, results were consistent for online courses suggesting a higher mastery of motivation and positive emotions after taking the course, although it was in many ways similar to a traditional course. Finally, online course might have been associated with higher scores in context control than traditional course but it could depend of the course content.

1. Objectives or purposes

This research seeks to contribute with a quantification of the various self-regulated learning (SRL) aspects in a same study, considering together six factors associated to SRL (cognition, metacognition, motivation, emotions, context control and behavior) in order to better assess the differences that exist between students who follow an online course vs. those who follow the same course in a more traditional classroom setting.

2. Theoretical framework

Self-regulated learning refers to learners' systemic use of metacognitive, motivational, and behavioral strategies to achieve academics goals (Zimmerman, 1990). Self-regulated learning also includes cognitive regulation (Taub, Azevedo, Bouchet, & Khosravifar, 2014), use of emotional strategies (Artino Jr., & Jones II, 2012) and taking into account context concerns (Tsai, 2013), which are described below.

Various authors suggest using online or hybrid/blended environments is beneficial to develop self-regulated skills, especially *cognitive* skills (Pintrich, 2004; Taub et al, 2014). *Cognitive* skills refer to a bundle of mental processes such as the acquisition, organization, and use of knowledge (Neisser, 1976). Self-regulated learning implies the use of processes such as setting

goal, defining task strategies (Dabbagh, & Kitsantas, 2005), and activating prior knowledge (Taub et al., 2014).

Metacognition defined as “a higher-order agent overlooking and governing the cognitive system, while simultaneously being part of it” (Veenman, Hout-Wolters, & Afflerbach, 2006, p. 5) includes cognitive judgments which refer to reactions and reflection from students about how they learn. Moreover, the attribution of their performance attempting to regulate their learning process (Pintrich, 2004) implies critical thinking, which refers to "the capacity to critically analyze learning material" (Richardson, Abraham, & Bond, 2012, p. 357), and metacognitive strategies, which refer to the awareness to monitor, plan and regulate learning (Yukselturk & Bulut, 2007) helping to retain knowledge (Broadbent & Poon, 2015).

Motivation is another factor which plays a key role in SRL. It has been defined as a set of beliefs that influence people’s movement towards attainment of valued goals (Pintrich, & Schunk, 1996). These goals can be intrinsic, where the motivation stems primarily from internal reasons (e.g., being curious, wanting to challenge, wanting to master the content), or extrinsic, i.e. : “caused by primarily external reasons (e.g., getting good grades, competing with others, and seeking approval or rewards)” (Youn, Chyung, Moll, & Berg, 2010, p. 23).

Another less considered yet also important factor in the study of SRL has been emotions. This process generally distinguishes valence (positive vs. negative) and arousal (high vs. low). Positive “emotions such as enjoyment, hope, and pride are thought to promote both intrinsic and extrinsic motivation, facilitate the use of flexible learning strategies, and support self-regulation, thus positively affecting academic performance under most conditions" (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011, p. 38).

The *context* in SRL is focused on the aspects relative to the control and regulation of the physical context (Pintrich, 2004; Zimmerman, 1998). The importance of this element of SRL is about the time invested outside the classroom. Thus, considering context in online courses implies considering the structure of the study environment (Barnard, Paton, & Lai, 2009).

Last, *the behavior* is a particular element in the study of SRL because if some processes such as cognition, metacognition, and motivation imply internal processes, they are eventually translated into behaviors (Bandura, 1991). Two behaviors, in particular, have been widely studied in SRL: help-seeking which refers to "online tools, including search engines and communication

platforms" (Hao, Wright, Barnes, & Branch, 2016, p. 467) and time-management which involves self-monitoring and managing one's time effectively (Terry & Doolittle, 2008, p.197).

3. Methods

Participants in this study were 156 student's volunteers (first-year university students with the same profile and courses taken) who signed an informed consent from psychology higher education at the largest public university in Baja California Mexico. We consider two sets of students: the first set followed a course in cognitive psychology (CogPsy), and the other one in educational technology (EdTech). In each set, students were randomly assigned to either take the course in a traditional classroom manner (control condition), or to take it online (experimental condition). The pedagogical content was exactly the same in either condition. 49 participated in CogPsy online group (G1_{Online}), and 28 in a CogPsy traditional course (G2_{Traditional}); while 53 in EdTech online course (G3_{Online}), and 26 in EdTech traditional course (G4_{Traditional}). Bonus points representing 10% of the grade were assigned for the participants in each group to encourage them to answer to the questionnaires. The sample characteristics are described in Table 1.

Insert Table 1. Sample characteristics

For the development of the first set of students, we used the content of the CogPsy course presented using a Blackboard platform for the online group and a traditional class (face-to-face) based on the same instructional design which included three main modalities by each theme: 1) teacher explanation, 2) reading about the topic, and 3) writing evaluation. Overall, the course lasted 16 weeks. At the end of the course, participants filled the questionnaire adapted from some scales of the OSLQ (Barnard et al, 2009), the AEQ (Pekrun, et al, 2011), and the MSQL (Pintrich, Smith, García, & McKeachie, 1991). The version for the control group was a straightforward adaptation of the online questionnaire for the classroom, replacing all questions which mentioned online environments by classroom course. A One-way MANOVA analysis was calculated for all scales of the instrument which did not violate the normality and homogeneity criteria, and a non-parametric Kruskal-Wallis test was used in cases where violation was detected.

The second set of students followed a course on EdTech. Similarly to the CogPsy course, content was presented using Blackboard and participants responded to the aforementioned questionnaires (an online version for the online course, and a paper version of the questionnaire

for the control group) at the end of the course. Nevertheless, in this condition, participants in the online course answered to both a pretest and a posttest version of the questionnaire, while students in the traditional classroom condition only responded a posttest version. Both courses were conducted by the same professor.

Due to the non-normality of the dataset, a Wilcoxon signed-rank test was utilized for pretest-posttest comparison, and Kruskal-Wallis tests were used to compare different groups for all scales.

Insert Table 2. Scales and subscales items, Cronbach's alpha by factor

Hypothesis

According to theory, the use of online environments for learning require the development of SRL skills in cognition, metacognition, motivation, emotion, context and behavior. Following this premise, this study raises the following hypothesis:

1. H_0 : There are no significant differences in any factor in the development of SRL in an online course compared to a traditional classroom course for students in terms of cognition, metacognition, motivation, emotion, context and behavior.
2. H_1 : There are significant differences for at least one factor in the development of SRL in an online course for students in terms of cognition, metacognition, motivation, emotion, context and behavior.

4. Materials

The questionnaire comprised of three sections: the first one included three identification questions, the second one was made of 42 questions divided into six scales to measure SRL and a final section about generalities of the course as listed in table 2. Sections (dependent variables), scales, subscales, items, Cronbach's alpha by group and condition questionnaire are shown in table 2. The overall Cronbach alpha for the experiment one was 0.80, while 0.74 for experiment two.

Insert Table 3. Descriptive and significances of experiment one

Insert Table 4. Descriptive and significances of experiment two

5. Results and substantiated conclusions

Statistical analysis of means has produced the following results. The results reveal that taking online and traditional courses are strongly related to higher values on motivation factor (intrinsic and extrinsic) as can be seen in table 3 and 4. Regarding emotion factor, results for all groups were parallel on enjoyment, hope, and proud, getting the highest values excepting in proud emotion for CogPsy C2_{Traditional}.

The comparison between online and traditional classroom in the experiment one through parametric and non-parametric statistics has produced the following results. Item 11 from the CogPsy was higher for G1_{online} (M=4.02) than from G2_{Traditional} (M=3.29), and item 12 (M=4.10) was higher for G1_{online} (M=4.10) than G2_{Traditional} (M=3.54) on the context scale, whereas item 6 was statistically significantly higher for G2_{Traditional} (M=4.04) than from G2_{Online} (2.92) on the cognitive scale.

Regarding the comparison between EdTech G3_{online} and G4_{Traditional} (posttest) from the experiment two, the significant difference is between motivation factor, showing higher values on the item 26 for G3_{online} (M=4.09) than from G4_{Traditional} (M=3.92), while higher values for G4_{Traditional} in items 27 (M=4.04) than from G3_{online} (M=3.91), 29 (M=4.12) than from G3_{online} (M=3.77), and 31 (M=4.08) than from G3_{online} (M=3.13).

On the basis of the results obtained, this study agrees with the hypothesis which considered that taking an online course is related to higher values of intrinsic and extrinsic motivation but it has not an statistically significantly higher impact than traditional course, in contradiction to Youn, et al (2010). Second, students can feel more of a certain emotion such as proud in online delivery than traditional, in line with Pekrun, et al (2011). Online delivery also appear to be associated to higher levels of control context in line with Pintrich (2004), and Zimmerman (1998). Nonetheless, other characteristics such as the course content might be associated with higher scores in the control for online delivery because we only found significant differences for CogPsy.

Finally, in both experiments students from all groups appear to be in highly agree with item 30 (M₁=4.00, M₄=4.12) “*The most important thing for me now is improving my overall grade point average, so my main concern in this class is getting a good grade*”, which speaks of the importance of the extrinsically motivation.

In summary, we have presented a comprehensive quantification providing insight into the SRL factors. Our results provide compelling evidence that taking online courses is strongly related to higher scores on motivation and positive emotions, almost the same in both online groups but not necessarily than traditional delivery. Regarding emotions, positive emotions are highly related to online courses but experiment two indicates that positive emotions were showed by students before taking the EdTech G3_{Online}.

6. The scientific or scholarly significance of the study or work

The present study contributes to the emerging literature, methods, and results on SRL in online environments. This research has included the most studied processes respecting SRL in online environments: cognitive, metacognitive and motivation. In addition, the model added processes less studied such as emotions, behavior and context control, and therefore allows us to have a comprehensive overview of the nature of the differences between students learning online vs. traditional in a classroom.

Limitations

Our approach has potential and the method could be applied in a bigger sample than the current study using pretest-posttest experimental designs even in control groups. It could help us to conclude with certainty on whether it is the online course that had an effect on the development of various factors of SRL. We can only conclude about SRL processes related to online courses and that differences exist between these populations at the end of the study. Finally, there was difficulty to determine differences by gender due the larger sample for female students.

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Tables

Table 1. Sample characteristics

Characteristics	Experiment One			Experiment Two		
	Total Sample (n = 77)	G1Online (n = 49)	G2Traditional (n = 28)	Total Sample (n = 79)	G3Online 1 (n = 53)	G4Traditional (n = 26)
Age Mean		20.55	20.96		19.57	19.88
Age STD		2.19	2.40		1.45	1.56
Gender						
Female	60	37 (76%)	23 (82%)	53	33 (62%)	26 (77%)
Male	17	5 (24%)	12 (18%)	26	20 (38%)	6 (21%)

Table 2. Scales and subscales items, Cronbach's alpha by factor

Factor	Sub-scale	Items						Adapted from
			α^1	α^2	α^3	α^4	α^5	
Cognition	Goal Setting	1. I set standards for my assignments in online courses.	.542	.497	.682	.760	.666	OSLQ

	Task Strategies	<p>2. I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the semester).</p> <p>3. I kept a high standard for my learning in my online courses.</p> <p>4. I set goals to help me manage studying time for my online courses.</p> <p>5. I didn't compromise the quality of my work because it was online.</p> <p>6. I tried to take more thorough notes for my online courses because notes are even more important for learning online than in a regular classroom.</p> <p>7. I have read aloud instructional materials posted online to fight against distractions.</p> <p>8. I prepared my questions before joining in the chat room and discussion.</p> <p>9. I have worked extra problems in my online courses in addition to the assigned ones to master the course content.</p>						
Context	Environment Strategies	<p>10. I choose the location where I study to avoid too much distraction.</p> <p>11. I find a comfortable place to study.</p> <p>12. I know where I can study most efficiently for online courses.</p> <p>13. I have chosen a time with few distractions for studying for my online courses.</p>	.647	.775	.812	.858	.502	OSLQ
Behavior	Time management	<p>14. I allocated extra studying time for my online courses because I know it was time demanding.</p> <p>15. I tried to schedule the same time every day or every week to study for my online courses, and I observed the schedule.</p>						
	Help-seeking	<p>16. Although we didn't have to attend daily classes, I still tried to distribute my studying time evenly across days.</p> <p>17. I have found someone who is knowledgeable in course content so that I consulted with him or her when I've needed help.</p> <p>18. I shared my problems with my classmates online so we knew what we were struggling with and how to solve our problems.</p> <p>19. If needed, I tried to meet my classmates face-to-face.</p> <p>20. I have been persistent in getting help from the instructor through e-mail.</p>	.651	.731	.713 when deleted	.780	.843	OSLQ
Metacognition	Self-evaluation	<p>21. I have summarized my learning in online courses to examine my understanding of what I have learned.</p> <p>22. I ask myself a lot of questions about the course material when studying for an online course.</p> <p>23. I have communicated with my classmates to find out how I was doing in my online classes.</p> <p>24. I have communicated with my classmates to find out what I was learning that is different from what they are learning.</p>	.686	.719	.724	.772	.742	OSLQ
Motivation	Intrinsic Goal Orientation	<p>25. In a class like this, I preferred course material that really challenges me so I can learn new things.</p> <p>26. In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.</p> <p>27. The most satisfying thing for me in this course was trying to understand the content as thoroughly as possible.</p> <p>28. When I had the opportunity in this class, I chose course assignments that I could learn from even if they don't guarantee a good grade.</p>	.688	.573	.912	.920	.867	MSQL
	Extrinsic Goal Orientation	<p>29. Getting a good grade in this class is the most satisfying thing for me right now.</p> <p>30. The most important thing for me now is improving my overall grade point average, so my main concern in this class is getting a good grade.</p>						

		31. If I can, I want to get better grades in this class than most of the other students.						
		32. I hope to have done well in this class because it is important to show my ability to my family, friends, employer, or others.						
Emotion	Learning-related emotions:							
	Enjoyment	33. I enjoy acquiring new knowledge.						
	Hope	34. I have an optimistic view toward studying.	.598	.725	.671	.657	.755	AEQ
	Proud	35. I'm proud of my capacity.						
	Anger	36. Studying makes me feel irritated. REVERSED						
	Anxiety	37. I get tense and nervous while studying. REVERSED						
	Shame	38. I feel ashamed that I can't absorb the simplest of details. REVERSED						
Additional	General use of online platform (A)	39. I consider easy the use of the online platform to understand the subject matter of the course.						
		40. In a class like this, I would have preferred a traditional class.	.751	.765	.765	.715	.843	
		41. I consider online mode adequate for this course.						
		42. The online platform used in this course has been friendly for me.						

Note:

¹ G1Posttest online

² G2Posttest Traditional

³ G2Pretest online

⁴ G2Posttest online

⁵ G3Posttest Traditional

Table 3. Descriptive and significance of experiment one

	Item	G1 _{Online}		G2 _{Traditional}		Sig.
		Mean	Std. deviation	Mean	Std. deviation	
Cognition	1	3.69	0.89	3.64	0.83	0.81
	2	3.43	1.12	3.50	0.92	0.78
	3	3.51	0.98	3.46	0.64	0.62
	4	3.35	1.01	3.61	0.83	0.25
	5	3.00	1.14	2.82	1.22	0.52
	6	2.92	1.13	4.04	0.96	0.00*
	7	3.20	1.41	2.96	1.40	0.47
	8	3.00	1.15	2.82	0.98	0.49
	9	2.78	1.03	2.79	1.07	0.97
Context	10	3.82	1.17	3.25	1.27	0.05*
	11	4.02	0.80	3.29	1.12	0.00*
	12	4.10	0.94	3.54	1.07	0.02*
	13	3.69	1.06	3.46	1.10	0.37
Behavior	14	3.29	1.08	3.07	0.98	0.39
	15	3.41	1.14	2.89	0.96	0.05*
	16	3.22	1.07	2.96	1.00	0.00**
	17	2.76	1.16	2.79	1.07	0.91
	18	3.88	1.03	3.75	0.84	0.58
	19	4.24	1.01	3.93	0.94	0.18
	20	3.86	1.08	2.75	1.24	0.00
Metacognition	21	3.10	1.03	3.11	0.92	0.98
	22	3.39	1.08	3.39	0.79	0.98
	23	3.94	1.11	3.29	1.12	0.02*
	24	3.76	1.11	3.36	1.13	0.14
Motivation	25	4.80	1.34	5.25	1.38	0.16
	26	5.86	1.41	5.96	1.17	0.74
	27	5.80	1.55	5.50	1.29	0.40
	28	4.49	1.65	4.96	1.35	0.20

	29	5.33	1.72	4.89	1.81	0.30
	30	5.22	1.67	4.64	1.91	0.17
	31	4.65	1.83	5.21	1.64	0.18
	32	4.24	2.26	4.68	1.76	0.00**
Emotion	33	4.55	0.77	4.29	0.98	0.19
	34	4.45	0.79	4.04	1.07	0.06
	35	4.22	0.94	3.71	1.08	0.03*
	36	2.24	1.23	2.36	1.45	0.72
	37	2.65	1.15	2.75	1.32	0.74
	38	3.43	1.19	3.25	1.11	0.52
General	39	2.86	1.26	3.32	1.12	0.11
	40	4.04	1.32	1.64	1.16	0.00*
	41	2.71	1.32	3.21	1.34	0.12
	42	3.22	1.21	3.46	1.26	0.41

*Significant at $p \leq 0.05$

** Kruskal Wallis analysis

Table 4. Descriptive and significance of experiment two.

Variable	Items	G3 _{Online} Pretest		G3 _{Online} posttest			G4 _{Traditional} posttest		
		Mean	Standard deviation	Mean	Standard deviation	<i>p</i>	Mean	Standard deviation	<i>p</i>
Cognition	1.00	3.83	0.73	3.85	0.81	0.89	3.73	0.67	0.06
	2.00	3.64	0.74	3.72	0.74	0.57	3.73	0.72	0.86
	3.00	3.70	0.75	3.75	0.76	0.67	3.85	0.54	0.66
	4.00	3.83	0.80	3.68	0.84	0.41	3.85	0.73	0.46
	5.00	3.94	1.13	3.75	1.13	0.52	3.92	1.09	0.54
	6.00	3.43	0.95	3.11	1.08	0.11	3.62	0.94	0.08
	7.00	3.42	1.25	3.43	1.18	0.85	3.19	1.06	0.29
	8.00	3.66	1.06	3.74	1.09	0.64	3.58	0.90	0.33
	9.00	3.17	0.94	3.25	1.09	0.80	3.27	1.04	0.89
Context	10.00	3.83	1.09	3.92	1.11	0.44	3.85	1.01	0.06
	11.00	4.00	0.96	3.77	1.03	0.27	4.04	0.77	0.36
	12.00	4.04	0.90	3.87	0.96	0.41	4.12	0.65	0.41
	13.00	3.81	0.92	3.45	1.20	0.09	3.73	0.87	0.472
Behavior	14.00	3.32	0.96	3.09	0.95	0.23	3.62	0.94	0.02*
	15.00	3.43	1.03	3.11	1.12	0.23	3.54	0.81	0.10
	16.00	4.91	0.77	3.40	0.95	0.004*	3.69	0.84	0.24
	17.00	3.66	0.81	2.89	1.22	0.000*	3.31	1.12	0.16
	18.00	3.94	0.91	3.64	1.21	0.28	3.92	0.98	0.35
	19.00	4.11	0.91	3.91	1.03	0.40	4.27	0.67	0.18
	20.00	3.45	0.93	3.34	1.16	0.78	3.42	1.14	0.84
Metacognition	21.00	3.60	0.82	3.26	1.01	0.10	3.58	0.81	0.26
	22.00	3.58	0.80	3.68	0.84	0.53	3.58	0.86	0.59

	23.00	3.58	0.97	3.64	1.05	0.89	3.69	0.88	0.86
	24.00	3.79	0.95	3.72	1.04	0.68	3.69	0.88	0.76
	25.00	3.68	0.98	3.58	1.04	0.65	3.58	0.81	0.01*
	26.00	4.06	1.01	4.09	1.02	0.80	3.92	0.89	0.01*
	27.00	3.98	1.05	3.91	1.00	0.64	4.04	0.72	0.00*
Motivation	28.00	3.53	1.12	3.53	1.08	0.83	3.46	0.99	0.04*
	29.00	3.89	1.01	3.77	0.97	0.74	4.12	0.91	0.00*
	30.00	4.04	1.11	4.00	1.05	0.77	4.12	0.99	0.00*
	31.00	3.70	1.07	3.13	1.23	0.016*	4.08	1.02	0.00*
	32.00	3.51	1.22	3.11	1.27	0.12	3.62	1.02	0.00*
	33.00	4.83	0.55	4.72	0.68	0.36	4.62	0.85	0.55
	34.00	4.47	0.70	4.47	0.75	1.00	4.54	0.86	0.46
Emotion	35.00	4.42	0.77	4.34	0.81	0.78	4.23	0.82	0.46
	36.00	1.70	0.89	1.79	0.95	0.52	1.85	0.97	0.80
	37.00	2.23	1.05	2.36	1.21	0.59	2.58	1.03	0.33
	38.00	3.19	1.21	3.00	1.24	0.39	3.35	1.16	0.25
	39.00	3.64	0.92	3.91	1.14	0.20	3.85	1.05	0.61
General use	40.00	2.64	1.29	2.75	1.41	0.82	2.27	1.19	0.16
	41.00	3.92	0.98	4.25	0.91	0.09	3.96	0.92	0.11
	42.00	3.96	0.94	3.96	1.18	0.90	3.88	0.91	0.34

*Significant at $p \leq 0.05$