

1 Article

2 **Sustainable peer feedback in higher education:  
3 category-driven analysis on pre-service students'  
4 perceptions**

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16

17 **Abstract:** Students who had been actively engaged in mediated collaborative activities, were asked  
18 for their perceptions about the sustainable peer feedback they had received and provided. Their  
19 views were then analyzed and categorized in terms of receiver and provider feedback, cognitive  
20 feedback and previously acquired feedback to further knowledge about sustainable education  
21 processes. A peer supported feedback questionnaire was created and validated, and its categories  
22 were correlated. The questionnaire was then aligned with the activities used to foster peer feedback  
23 between the pre-service students from the three bachelor's degrees. The perceptions the students  
24 had of the feedback processes were analyzed using defined peer support feedback categories and  
25 the results showed a correlation between cognitive feedback and both provider and receiver self-  
26 efficacy feedback. In addition, there was a further correlation between both provider and receiver  
27 self-efficacy feedback as well as provider and receiver involvement and feedback structure.  
28 However, the results also revealed that neither receiver nor provider autonomy support were  
29 significant categories for supportive feedback.

30 **Keywords:** sustainable feedback, peer feedback, higher education, peer receiver, peer provider.  
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32 **1. Introduction**

33 Sustainable education in higher education fosters skills in initiative such as being proactive and  
34 more independent and thinking critically [1]. In higher education, once the active role of students is  
35 acknowledged, the concept of sustainable education relies on learners making sense of information  
36 from various sources and using it to enhance their learning strategies [2]. It also entails the ability of  
37 teachers to promote student interaction and foster relationships in socialization and learning [3-5].  
38 Sustainable education is grounded in proactive processes that ensure educational problems are  
39 eliminated before they occur [6]. Learner-driven strategies are essential to sustainable education and  
40 so developing students' abilities and skills demands engaging students through action [7]. Within  
41 the teaching-learning context, metacognitive theory emphasizes that students are self-regulating and  
42 responsible for their own learning as teachers guide them in the process. Feedback begins with  
43 students and teachers putting a continuous process of cyclical interaction in place. Meanwhile, the  
44 theory of social constructivism focuses on knowing how students actively participate when

45 constructing their knowledge [8,9], i.e., from the perspective of students co-constructing through  
46 dialogue and sense-making strategies [2,10]. The starting point of sustainable feedback is a student's  
47 pre-existing knowledge, especially in the sphere of peer interaction, as it is the student who becomes  
48 the protagonist because feedback is no longer teacher controlled. Within this educational paradigm,  
49 feedback is not an evaluative process, it does not judge but instead it is a balanced, constructive and  
50 stimulating process of inherent interest for the students themselves.

51 Sustainable feedback is based on social constructivism approaches [11]. First, the quality of  
52 student performance is fostered when students are involved in dual peer-to-peer dialogues either  
53 through designed activities or learning. Second, a student's capacity to monitor and evaluate their  
54 own learning is developed along with the capacities for ongoing, lifelong learning, for goal setting  
55 and for planning their own personal learning outcomes. Third, specific disciplines, curricula and  
56 contextual assessment tasks are designed to facilitate student engagement over time. In this context,  
57 feedback is generated from varied sources, processed and used to enhance performance on the  
58 multiple stages of assignments. By fostering sustainable feedback, students are trained in decision-  
59 making and initiative skills that lead to autonomy and critical thinking [12-14]. But at the same time,  
60 students must understand the value feedback has and the active role they play in the process, either  
61 as the provider or receiver of the feedback [2].

62 Sustainable feedback benefits all the agents involved in the learning process and can be observed  
63 from the perspective of the feedback provider and/or that of the receiver [15-17]. When analyzing the  
64 work of their peers, the student feedback providers must first reflect on their own work which will  
65 contribute to improving the quality of what they themselves produce from the outset [18,19].  
66 Likewise, this contributes to creating reflective knowledge because, during the process, peers must  
67 produce evaluation appraisals not only on the work of others, but also on their own in relation to that  
68 of the group [20-22]. Finally, reflection is reinforced because when issuing an evaluation appraisal,  
69 the feedback provider must provide a coherent explanation. Although peer feedback is also mediated  
70 by students' perceptions of the peer feedback they receive [17,23], students usually perceive  
71 providing, rather than receiving, peer feedback is more beneficial [17,24-25]. Generally, peer feedback  
72 means that both the provider and the receiver are more motivated by the in-class activities when they  
73 see themselves totally involved and implicated in the entire process [21].

74 Although research usually focuses on the understanding, capacity and disposition needed to  
75 make sense of information and its use to enhance learning strategies [2], this paper focuses on peer  
76 feedback research, specifically analyzing the perceptions that pre-service students attain in their role  
77 as feedback provider or receiver. We are interested in defining categories that can describe the process  
78 in terms of how developing peer feedback provides structure, autonomy and involvement, as well as  
79 self-efficacy. We base our analysis on the (so far) not-yet-described need-supportive feedback  
80 approach which aims to analyze students' basic needs. Need-supportive feedback distinguishes three  
81 basic needs: (i) feedback autonomy, (ii) structure for both provider and receiver involvement which,  
82 together with (iii) self-efficacy, promote students' self-regulated learning [26]. For students, cognitive  
83 feedback (both provider and receiver) relates to how cognitively challenging the instructional  
84 strategies and the selected learning tasks are and how thought-provoking the teacher's instructional  
85 strategies are [27]. Self-efficacy, in the context of peer feedback, can be defined as appraisals of  
86 individual skills to bring about the desired outcomes of student engagement and learning [28]. In the  
87 model we purpose, peer self-efficacy feedback has been operationalized as a dimension construct that  
88 also includes efficacy for both the receiver and the provider's self-regulation and instructional  
89 strategies.

90 Therefore, this paper's focus is twofold: i) engaging pre-service students from three bachelor's  
91 degrees through collaborative activities and peer feedback and ii) evaluating the ensuing peer  
92 feedback using an analytical model of students' basic needs categories. The needs categories were  
93 divided into four blocks: received feedback, provider feedback, cognitive feedback and prior notions  
94 of feedback. The first two were analyzed as a function of the pre-service students' involvement,  
95 autonomy support, structure and self-efficacy. We quantitatively analyzed the four blocks which  
96 were further divided into ten categories supported by seventeen questions, all of which determine

97 the perceptions students had about the feedback processes they were involved in. By statistically  
98 analyzing the ten correlated categories we are able to determine the most significant interactions that  
99 define the co-construction knowledge of students working with supportive feedback. Although some  
100 research on the perceptions teachers and higher education students have about sustainability and  
101 sustainable education exists [7,29-31], there are very few studies that deal with student perceptions  
102 about learner-driven sustainable supportive feedback.

103 **2. Methods**

104 *2.1. Context*

105 The experiment was carried out with three groups of students taking one of three bachelor's  
106 degrees in Education at the University of Girona: Bachelor's degree in Early Childhood Education,  
107 Bachelor's degree in Primary School Education, and the double degree in Early Childhood and  
108 Primary School Education. In the Spanish curriculum, teacher education is based on a four-year study  
109 program. Our experimental study was carried out during a 75-hour module for all three degrees at  
110 the Faculty of Education and Psychology (University of Girona, Spain).

111 *2.2. Participants*

112 There were one hundred and eighty-one participants in total, and the ages ranged between 18  
113 and 37 years old; albeit the great majority (86%) being between 18 and 25 years old. The sample had  
114 a higher percentage of female (79%) to male students (21%). Of the students involved, 32% were doing  
115 their bachelor's degree in Early Childhood Education, 53% were in Primary School Education, and  
116 15% were doing the double degree.

117 *2.3. Peer Feedback Activities*

118 All the peer activities proposed to all the students involved in the study were designed around  
119 collaborative learning.

120 The pre-service students from the Bachelor in Primary School Education were initially put into  
121 groups of three and asked to produce a scientific graphical abstract based on an experimental  
122 scientific experience. Feedback was initiated through peer interaction within the groups of three.  
123 Dialogue between the feedback receiver and the two providers was centered on the changes the  
124 feedback providers proposed for improving the quality of the (receiver's) initial abstract. All three  
125 students received feedback (one interaction) and provided feedback (two interactions). Next, each  
126 student replotted their graphical abstract by taking into consideration the feedback they had received  
127 from their groupmates. Thus, a second version was developed. The activity was repeated once a week  
128 for a total of six weeks, i.e., a total of six peer feedback interactions. The interaction between students  
129 was based on true peer collaborative learning [32]. True peer collaborative learning maximizes the  
130 supportive feedback between the provider and the receiver. Since the students from each group were  
131 all 'in the same boat' (i.e., completely unfamiliar with the new material), they developed the activity  
132 by following a (teacher provided) fixed and controlled script in order to improve their processing  
133 and retention of the learning tasks. Although this script can be applied to different types of tasks,  
134 such as reading or writing, we related it to the peer collaboration between the three members of the  
135 group on a task that summarized acquired knowledge [33].

136 Meanwhile, the pre-service students from the Double Bachelor's degree in Early Childhood and  
137 Primary School Education were also put into groups of three and in a 'jigsaw activity' each member  
138 was given a piece of incomplete information. Thus, the need for reciprocal communication between  
139 all three members in each of the cooperative groups was generated [34]. The jigsaw technique  
140 considers each student in the group as a 'piece of the puzzle' and therefore essential to its completion.  
141 To this end students participating in each group were asked to integrate their piece of the puzzle into  
142 a final unique text. A jigsaw activity has four phases. In Phase 0, students are put into groups of (in  
143 our case) three. One example of a jigsaw activity is a text divided into three parts, (A, B and C), and  
144 each student is responsible for reading and understanding their given part. In our case, in Phase 1

145 the students met to discuss and share the information they had been given (i.e. their part of the text).  
146 In Phase 2, the students then put the final text together. Once the final text from each group had been  
147 put together, two base teams were asked to produce feedback, one group providing feedback and the  
148 other receiving it. As with the students from the Bachelor in Primary School Education, the activity  
149 was repeated once a week over six weeks, (i.e., a total of six peer feedback interactions), with groups  
150 alternating their role as feedback provider or receiver. In other words, this activity employed  
151 reciprocal peer feedback [35].

152 The Early Childhood Education degree students' task was to carry out individual self-directed  
153 research about a specific subject proposed by the teacher. This research would later be presented to  
154 the rest of the members of a base team. This is a complex task because its main objective is to create  
155 a debate between the students [36]. Students were left to organize themselves in groups of four or six.  
156 As with the students from the other two bachelor's degrees, these students also met once a week for  
157 six weeks. Each week one member of the team presented their findings and the other team members  
158 provided them with feedback, i.e., reciprocal plural peer feedback [4].

#### 159 2.4. Peer Feedback Questionnaire and Conceptual Framework

160 The students were asked to answer the Peer Feedback Questionnaire (*PeerFQuest*) (Table 1).  
161 *PeerFQuest* was designed and created following a detailed analysis of prospect models dealing with  
162 introducing peer feedback processes into higher education. Once the questionnaire had been drawn  
163 up it was piloted and then implemented. To optimize the quantification of learning strategies,  
164 (especially in terms of multi-method research [37], metacognitive aspects [38], and methodological  
165 skills [39-41]), questionnaires are typically used. According to Leenknecht et al. [42], using  
166 questionnaires to complement tasks can give an accurate reflection of cognitive processing. Therefore,  
167 *PeerFQuest* is not only designed around the interaction between peers in the feedback process, and  
168 students' roles as provider or receivers, but also around the previous experience of experimental  
169 feedback and the cognitive processes inherent to supportive feedback.

170 As such, *PeerFQuest* was designed to obtain students' opinions and views about various aspects  
171 of supportive feedback. *PeerFQuest* was made up of four blocks. Block 1 had four categories  
172 concerning receiver feedback: involvement, autonomy support, structure and self-efficacy.  
173 Meanwhile, Block 2 had four categories on provider feedback: involvement, autonomy support,  
174 structure and self-efficacy. Finally, Block 3 had a single category on cognitive feedback and Block 4 a  
175 single category on previous feedback experience. The questionnaire had seventeen questions. The  
176 first two categories on either providing or receiving feedback are aligned with the teachers playing  
177 an important role in motivating students by providing and demonstrating autonomy support,  
178 structure (support of competence) and involvement (support of relatedness) [43,44]. Students who  
179 are motivated to learn are more likely to engage in activities and to ask for feedback [43].

180 According to the theory of self-determination, a learning environment should support students'  
181 basic psychological needs for autonomy, competence and involvement [43]. Indeed, an optimal  
182 process of need-supportive feedback should be facilitated by the psychological need for autonomy  
183 where students who provide and receive feedback feel that they are at the heart of their actions and  
184 that their actions are concordant with their values, among which include responsibility, commitment,  
185 criticism and perseverance [45]. Therefore, a high-quality feedback process must be autonomy-  
186 supportive [46]. In addition, providing and receiving feedback may be conceptualized as a specific  
187 aspect of structure [46] and is related to students' experience of effectiveness. Teachers that involve  
188 students in peer feedback, communicate the twofold expectations that feedback providers and  
189 receivers may encounter in the dual process of receiving and providing explicit informational  
190 feedback and support. The third category, involvement, aims to foster students' feelings of  
191 relatedness, i.e., the experience of close emotional bonds with significant others [43]. Feedback  
192 providers and receivers may show understanding and that they are available to offer support during  
193 the feedback process. Finally, self-efficacy in the feedback process means that both feedback  
194 providers and receivers have individual capabilities to bring about desired outcomes, especially in  
195 terms of student engagement and learning.

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**Table 1.** The seventeen questions, divided into ten categories, that make up the Peer Feedback Questionnaire. The first eight categories are related to students' perceptions about receiver and provider feedback, the ninth category is related to cognitive feedback and the tenth category to previously acquired experience in feedback processes.

Peer Feedback Categories and <i>PeerFQuest</i> questions	
1.	<b>Receiver feedback involvement:</b>
1.	1. Did you like receiving feedback from your partners?
2.	2. Was the feedback you received from your partners given in a kind and empathetic manner?
2.	<b>Receiver feedback autonomy support:</b>
3.	3. Do you think the feedback helped you improve your learning?
3.	<b>Receiver structure:</b>
4.	4. Was the feedback you received accurate and specific enough to improve your learning?
4.	<b>Self-efficacy receiver feedback:</b>
5.	5. Was the feedback you received helpful/beneficial for improving your learning?
5.	6. Were you able to modify your work so that the feedback you received improved your learning?
5.	<b>Provider feedback involvement:</b>
6.	7. Did you like giving your partners feedback?
6.	<b>Provider feedback autonomy support:</b>
7.	8. Do you think the feedback you gave was well-received?
7.	<b>Provider structure:</b>
8.	9. Did you think about being kind and empathetic when you fed back to your partners?
8.	10. To what extent did you use your previous knowledge of the topic to provide feedback?
8.	<b>Self-efficacy provider feedback:</b>
9.	11. Do you consider that your criticism of the work was precise/concrete and would improve your partners' learning.
9.	12. Do you think the feedback your partners received was useful and improved their learning?
9.	<b>Cognitive feedback:</b>
10.	13. Do you think providing and receiving feedback is useful for improving learning?
10.	14. Do you think providing and receiving feedback has improved your motivation to learn?
10.	15. Do you think that the feedback provided and received has improved your relationships with your partners?
10.	<b>Previous feedback experience:</b>
11.	16. Have you ever used feedback before as a teaching/learning strategy?
11.	17. Did you have any previous information about feedback as a methodological strategy before carrying out the activity?

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## 2.5. Statistical Analysis

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Students' answers to *PeerFQuest* (Table 1) were scaled on a Likert scale (1 = disagree, 5 = strongly agree) for questions 1 to 15 corresponding to Blocks 1, 2 and 3. Questions 16 and 17 were dichotomous questions requiring students to answer yes or no. A reliability analysis was conducted to ensure the dependability of the answers. This was done because good development procedures (usually) result in a reasonably reliable survey instrument [47-49]. For the whole set of the first three blocks, (i.e., the nine categories on peer feedback), Cronbach's coefficient alpha was 0.93, which is higher than 0.9, therefore ensuring that the *PeerFQuest* presents an excellent internal-consistency reliability [50,51]. In addition, an analysis of the capability to discriminate the questions of the *PeerFQuest* (Table 1) was carried out. To reinforce the individual character of the test, the index of homogeneity of each question in Table 1, (i.e., the Pearson coefficient), was used. The Pearson coefficient measures the score of each question in relation to the sum of the scores in the remaining questions, and the degree of the questionnaire's internal consistency. Thus, the Pearson coefficients for each question were calculated and, in all cases, the value of 0.3 was exceeded. There were minimum values for questions

215 9 and 10 (provider structure) with Pearson coefficients of 0.3 and 0.4, respectively, and maximum  
 216 values for questions 5 and 12, (self-efficacy feedback), with a Pearson coefficient of 0.8.

217 The analysis of the mean, standard deviation, asymmetry, kurtosis and correlation (Table 2), as  
 218 well the analysis of the internal consistency based on the Cronbach's and Pearson coefficients, were  
 219 carried out with the IBM SPSS Statistics 19.0.x software. A logistic regression was also carried out  
 220 using the same statistical program.

221 **3. Results**

222 Table 2 shows the main descriptive statistics from the nine categories used in this study and the  
 223 correlation there is between them. Although all correlations are positive and with a statistically  
 224 significant 99% confidence interval, we based our analysis on correlations larger than 0.65 which,  
 225 according to the literature, may be accepted as good analysis predictors of category dependencies.  
 226 The categories that were statistically significant were found between the cognitive feedback category  
 227 and both the self-efficacy provider (0.68), and the self-efficacy receiver (0.65) feedback categories. In  
 228 addition, the self-efficacy provider feedback category was highly correlated with both the self-  
 229 efficacy receiver feedback (0.73, being the highest), the provider feedback involvement (0.66) and the  
 230 provider structure (0.65) categories. Finally, self-efficacy receiver feedback was highly correlated with  
 231 the receiver feedback involvement (0.69) and receiver structure (0.66) categories. An analysis of the  
 232 correlation between the three blocks proved Pearson correlations higher than 0.71.

233 In terms of the descriptive statistics, one observes that most of the items have been completed in  
 234 their entirety (181) and that the majority present responses grouped around two or three values on  
 235 the scale (3, 4, 5), with the low values being practically unanswered. Hence, standard deviations are  
 236 less than one and the asymmetry is negative (a higher concentration in the upper part of the scale).  
 237 In relation to kurtosis, variability is observed within the same group. On the one hand there are items  
 238 with positive values, indicating a leptokurtic distribution (values > 0), which means that there is a  
 239 higher concentration of data around the mean. On the other hand, there are items with negative  
 240 values, indicating a more flattened distribution, which is known as platykurtic distribution (values <  
 241 0) and indicates a lower concentration of data around the average. Finally, Block 3 (cognitive  
 242 feedback) presents a kurtosis very close to 0, therefore its distribution is very similar to a Gaussian  
 243 distribution.

244 **Table 2.** Number of answers (N), Mean (M), Standard Deviation (SD), Asymmetry (A), Kurtosis (K)  
 245 and correlations between the categories. Note: All correlations were significant at level 0.01.

	N	M	SD	A	K	2	3	4	5	6	7	8	9
247 1 R. f. involvement	181	4.3	0.76	-1.2	1.7	0.38	0.58	<b>0.69</b>	0.50	0.58	0.38	0.61	0.57
248 2 R. f. autonomy support	177	3.8	0.96	-1.3	2.7		0.37	0.58	0.39	0.23	0.27	0.41	0.53
249 3 R. structure	181	3.6	0.88	-0.3	0.1			<b>0.66</b>	0.49	0.54	0.57	0.43	0.61
250 4 Self-efficacy R f.	181	3.9	0.80	-0.6	-0.3				0.58	0.44	0.41	<b>0.73</b>	<b>0.68</b>
251 5 P. f. involvement	181	4.0	0.92	-0.6	-0.3					0.45	0.38	<b>0.66</b>	0.58
252 6 P. f. autonomy support	181	4.0	0.82	-0.6	0.4						0.37	0.60	0.47
253 7 P. structure	181	4.2	0.59	-0.6	-0.2							0.65	0.49
254 8 Self-efficacy P f.	178	4.0	0.73	-0.7	0.5								<b>0.65</b>
255 9 Cognitive feedback	181	4.1	0.74	-0.8	-0.0								

256 To analyze the relationship between the two dichotomous questions (*PeerFQuest* Q16 and Q17  
 257 previous feedback experience (Table 1)), a logistic regression analysis was carried out to determine  
 258 the impact each of the three blocks had on the probability of responding assertively. Neither analysis  
 259 yielded significant results. In any case, although there are no statistically significant estimators,  
 260 certain trends in the values were observed. Block 1 (Receiver feedback) and Block 2 (Provider  
 261 feedback) had a positive impact on Question 16, which asked about using feedback in previous  
 262 activities. Higher scores in both groups indicate a greater probability of responding affirmatively to  
 263 this question. On the other hand, unlike Blocks 1 and 2, higher scores in Block 3 presented a lower

265 probability of responding affirmatively to Question 16. For Question 17, (previously acquired  
266 information on feedback), Block 2 (provider feedback) had a positive impact, while Block 1, (receiver  
267 feedback), had very little impact (values very close to 1) and Block 3 tended to have a rather negative  
268 impact.

269 **4. Discussion**

270 Supportive peer feedback is a learner-driven strategy that is one of the basic elements of  
271 sustainable education; learning is promoted through interaction between students that, in a second  
272 stage, fosters students' co-construction of knowledge and acquisition of intuitive skills [2]. This  
273 manuscript clearly shows that developing pre-service education students' peer feedback literacy  
274 skills (especially on the levels of providing and receiving supportive feedback) enables them to put  
275 the feedback into effect. Our objective was to school the pre-service students' education in decision-  
276 making and initiative skills so they can go on to develop self-regulated learning and achieve higher  
277 levels of cognitive development. From the perspective of the students' perceptions of supportive  
278 feedback, we can deduce that there is an interplay between the dimensions involved in the supportive  
279 feedback processes and that learning depended on both self-reflection and the interaction between  
280 peers. The supportive peer feedback encouraged collaborative interaction not only on the level of the  
281 teacher developing collaborative activities, but also by asking students to reflect on the process of  
282 giving or receiving peer supportive feedback through the *PeerFQuest* questionnaire [2,14,20,52].  
283 Providing opportunities for dialogue and promoting evaluative appraisals represent examples of the  
284 kind of feedback literacy that can strengthen social-relational aspects of peer interaction and reduce  
285 power differentials and negative emotional reactions which could arise in a more teacher-directed  
286 feedback process [2,53].

287 The three main blocks describing supportive peer feedback were (approximately) equally  
288 correlated. The cognitive, provider and receiver feedback groups from the *PeerFQuest* (Table 1)  
289 presented similar correlations. For students providing and receiving feedback and the cognitive  
290 feedback, (i.e., the extent to which the peers' instructional strategies and the selected learning tasks  
291 were cognitively challenging [27]), correlated with both provider and receiver self-efficacy, in which  
292 students were aware of appraisals about their own abilities to bring about desired outcomes [28]. For  
293 instance, the students' perceptions of the benefits of providing versus receiving peer feedback, were  
294 found to successfully rework and modify writing assignments and performance in content, structure  
295 and style [17]. Furthermore, feedback providers have been reported to have made substantial  
296 advances in their writing abilities [54]. In our experiments, producing cumulative feedback during  
297 single or multiple feedback sessions could favor the positive perceptions of students' self-efficacy.  
298 Indeed, cumulative experience of multiple peer feedback events over time may positively affect  
299 students' attitudes, beliefs and/or performance [17].

300 By defining nine subcategories within the three blocks, we were able to identify robust  
301 correlations on the levels of inter-group analysis and intragroup subcategory analysis. Therefore, the  
302 students' answers to the peer feedback questionnaire determined the most correlated subcategories  
303 in the groups. We based our study on the students' basic psychological needs, competences,  
304 autonomy, involvement and self-efficacy.

305 Although the theory of self-determination postulates that a learning environment should  
306 support students' basic psychological needs for autonomy, competence and involvement, our  
307 findings showed that an optimal process of needs-supportive feedback was highly facilitated by the  
308 psychological needs of structure and involvement, correlating with self-efficacy, and summarized in  
309 the conceptual model in Fig. 1. That is, the students providing or receiving feedback (peer-to-peer  
310 feedback) improved their learning during the dual process of communicating/receiving feedback  
311 through dialogues [55]. These results are aligned with those of Yang and Carless [53] who described  
312 an enhancement of the dialogic feedback process using a feedback triangle formed by a cognitive  
313 dimension, the interpersonal negotiation of feedback and the feedback provision structure.

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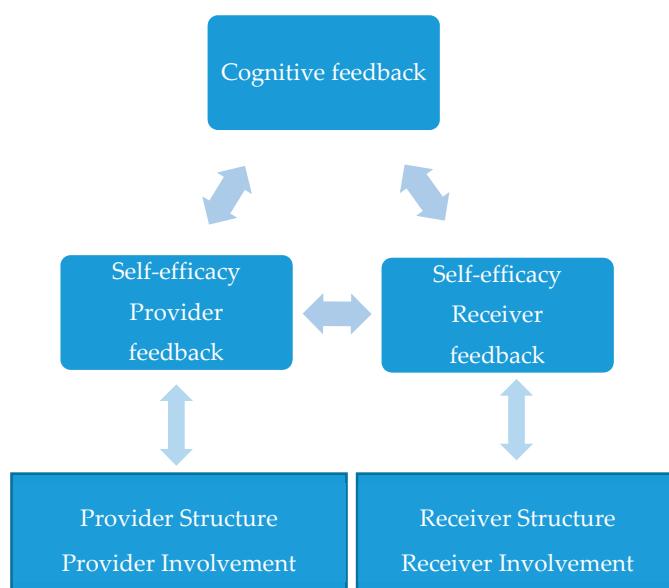
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334 **Figure 1.** Conceptual model of peer supportive feedback. Arrows between boxes=categories  
335 correspond to significant correlations.

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338 Furthermore, involvement, correlating to self-efficacy, aims to promote students' feelings of  
339 relatedness, i.e., fostering and promoting interpersonal emotional bonds with peers while receiving  
340 or providing feedback [53,54]. In other words, feedback providers and receivers may show  
341 understanding and empathy, and that they are available to offer support during the feedback process,  
342 either individually or in groups. The significant correlation between provider and receiver  
343 involvement and structure with self-efficacy means that both feedback providers and receivers have  
344 the individual skills required to bring about the desired outcomes, especially in terms of student  
345 engagement and learning.

346 All in all, this manuscript has shown that the architecture of supportive peer feedback based on  
347 collaborative activities, relies on the correlation between cognitive feedback and both provider and  
348 receiver self-efficacy feedback. In addition, there is a correlation between students' self-efficacy  
349 feedback and provider and receiver involvement and structure feedback. The inter and intra  
350 correlations between feedback dimensions on students' perceptions define a relevant message for  
351 peer feedback: peer feedback activities and evaluation, when designed in terms of sustainability,  
352 should include cognitive, metacognitive and self-efficacy [56]. Further research could be done by  
353 incorporating longitudinal information on students' efficacy at both receiving and providing  
354 feedback, or cognitive-verification of the activities that support the subsequent feedback process or  
355 on the accuracy of the types of activities that foster initiative skills for both the receivers and providers  
356 involved in sustainable feedback.

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