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On-Line Project-Based Peer Assessed Competitions as an Instructional Strategy in Higher Education

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Abstract

Project-based team competition is a well established instructional strategy with a sound constructivist rationale. However the implementation of this strategy in Higher-Education rarely includes socio-constructivist activities such as peer assessments, which have considerable advantages both for assessees and assessors. It seems that the logistics of orchestrating such activities might discourage many instructors. Recent e-learning environments, such as CeLS facilitate the pedagogical planning and remove the logistical burden involved with carrying out peer assessments. The paper describes online peer assessed competitions of team projects in several under-graduate courses and reports students' attitudes toward these activities. High correlations were found between the instructor's grading and those of the students. Peer assessments seemed to provide assessees with candid, rich, and multiple-perspective feedback. Students perceived peer assessments as valid regardless of the grade they received. Most students (72%) reacted favorably to the challenge of exposing their artifacts to peer judgments and believed that as a result of anticipating such judgments they invested more effort and thus improved the quality of their artifacts. Moreover, students' level of stress was correlated with putting more efforts into the products and feeling that as a result its quality improved.

Keywords: project-based learning, team competition, higher education, computer supported collaborative learning, peer assessment, students attitudes

Introduction

Project-based team competitions are retrospectively described by many students as key experiences – that is, experiences that had a lasting impact on students' life course (Yair, 2008). In a study that asked more than a thousand adults to describe educational key experiences, many brought back into memory challenging and authentic projects, involving team-competitions, followed by a public event where artifacts were presented (Yair, 2006). For instance, Armstrong (2002) describes such a reoccurring annual event, in a high-school setting, where geometry class students, aided by a local team of architects, designed and presented a futuristic school campus. This activity seemed to be a peak experience for everyone involved. However, project-based team competitions are far more than just a

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highly emotional event. Reeder (2007), the geometry teacher who led the above mentioned project, believes such activities have the potential to become one of the most useful and defensible instructional strategy of our age. Indeed, constructivist instructional approaches support this notion (e.g., Jonassen, 2012; Wilson, 2012). Moreover, research indicates that project-based team competitions – where a certain number of individuals cooperate as a group to compete against other groups – produce higher learning performances than cooperative learning or competition among individuals (Fu, Wu, & Ho, 2009; Ke & Grabowski, 2007; Slavin, 1980; Slavin, Leavey, & Madden, 1984).

The application of project-based team competition strategy is not restricted to high-schools and is applied in Higher Education across various programs such as Business Management (Casile, & Wheeler, 2005; Corner et al. 2006), Engineering (Cramer & Kurten, 2005; Sansalone, 1990), Computing (Fu et al. 2009), and Instructional Design (Kinzie, Hrabe, & Larsen, 1998; Rowland, 1994). For instance, Corner et al. (2006) describe a project-based team competition that takes place every year where business management students analyze a real-world complex case that faculty members produced with the help of local businesses. Students gave excellent evaluations to this activity and faculty members believe it is a wonderful experience. Cramer & Kurten (2005) describe a team competition conducted each year, where engineering students design, develop and test a canoe made of concrete as a peak experience in the program.

However, all these studies ignore one of the most important pedagogical resources relevant to team competition – peer assessments; typically, students' teams are assessed and ranked by juries or faculty member, but not by the students themselves. In higher education, peers have almost no input regarding their friends' projects flaws and merits, ways to improve it, etc. Yet, socio-constructivist theorists argue that peers are one of the most influential factors in knowledge construction (Cole, 1996; Lave & Wenger, 1991). According to such theories deep understanding requires dialogue and social negotiation (e.g., Flower, 1994). Peer assessment, in particular, has been shown to have many advantages both for assessees and assessors (Kali & Ronen, 2008). The assessees have an opportunity to reexamine their artifacts from fresh and multiple perspectives, which is particularly important in the case of creative and original artifacts. In addition, typically, peer assessment is more timely and more frequent than teachers' feedback, thus more useful for the assessees (Topping, 2003). As for the assessors, studies have indicated that peer assessment assists students to create higher quality artifacts. That is the case, probably, because the assessors become more reflective about their own work as a consequence of better understanding of the assessment criteria which they use when they play the role of assessors (Falchikov, 2003; Kali & Ronen, 2008; Smith, Cooper, & Lancaster, 2002; Topping, 2003).

Assuming that project-based peer assessed competitions might have pedagogical advantages, orchestrating it (assigning artifacts for peer assessments, calculating and publishing the results, etc.) is logistically complex, hence, decreases faculties' incentive to embrace such an initiative (Dillenboug & Jermann, 2010). Recent e-leaning environments may provide an efficient solution to this challenge by facilitating the design, orchestration and enactment of peer assessed competition activities, especially when dealing with original artifacts that are produced in digital formats (e.g., visual designs, musical pieces, architecture or product designs, interface designs, video clips, movie scripts).

The CeLS (Collaborative e-Learning Structures) is a web-based environment for designing and enacting collaborative online activities (Ronen, Kohen-Vacs, & Raz-Fogel, 2006) providing an efficient solution to such a challenge. Instructors use the CeLS to plan project-based competitions, and afterwards the successive stages are automatically handled by the system: students submit their product (the environment is designed to accept multimedia artifacts), then, the environment randomly assigns a predetermined number of anonymous artifacts for each student to assess. Finally, each artifact is publicly presented with peers' scores and anonymous verbal com-

ments adjacent to it. Typically each student receives scores and verbal comments from about 10-20 peers, depending on number of students in the class and number of artifacts each student is required to assess. Such a process allows for each artifact to be analyzed from multiple perspectives and gives each student potentially rich and multifaceted feedback. Since the CeLS environment supports the instructor in planning the activity and automates its enactment, using peer assessed competition as an instructional strategy does not put too many extra demands on the instructor. In our study the CeLS environment was used to handle peer assessed competition activities in college level courses.

The Study

This study explores the pedagogical aspects of a peer assessed competition as an instructional approach in higher education. Our aim was to assess the quality and perceived value of the feedback students provide on their peers artifacts, and to find out some of the motivational factors related to the fact that students know that their artifacts will be assessed and ranked by their peers, and eventually will be publicly discussed in front of the whole class. How do students feel about such circumstances? Do they feel intimidated? Does it energize them? Do they put more effort into the project then they would normally do? Do they appreciate their peers' feedback? Do they find it valuable and trust worthy? In particular the study addresses two main issues:

- How reliable are peer assessments? Do they correlate with the instructor's assessments? Do students appreciate such assessments?
- To what extent students feel that the web-based competition motivated them and encouraged them to submit better artifacts or, on the contrary, inhibited them and adversely affected their performance?

Participants & Activities

Participants were 1st and 2nd year undergraduate students in an Instructional Technology B.A. program in a technological college. During their three years of studies students are involved in many team projects. In the first two years all students take the same compulsory courses, while elective courses are offered only in the 3rd year. As a result of these circumstances students' cohorts form very cohesive groups. This fact may have implications on the ways students experience the need to assess peers, the experience of being assessed by peers, and the experience of overt competition.

Overall five groups (classes) participated in the study during the academic years of 2009-2011. Three groups of three consecutive 1st first year students cohorts, participated in an Introduction to Psychology course (overall 103 students). As part of the Social Psychology unit of the Introduction to Psychology course, students were challenged to apply attitude-change principles and design a poster and a brochure. Each year students had a different challenge: the first cohort designed a poster encouraging parents to send their children to open education schools (referred later as the "open education" activity), the second cohort encouraged parents and teachers to be more involved in preventing bullying is schools(referred later as the "bullying" activity), and the third cohort addressed fellow students and tried to encourage them to reduce their non-legitimate usage of mobile devices during lectures (referred later as the "multitasking during lectures" activity). Peer assessment and competition in these groups dealt with the efficacy of the posters and their potential impact for raising awareness and attitude-change.

Another two groups of two consecutive 2nd year students cohorts participated in a Web based Inquiry Learning course (overall 73 students). As part of the course the students were challenged to design a prototype of a WebQuest, which is an inquiry learning environment based on Web resources (Dodge, 1995). The students were encouraged to use a list of predefined project evalua-

tion criteria (rubrics) (Dodge, 2001) that were intended to facilitate their design efforts, and later on their peer assessments. Peer assessment and competition in these groups dealt with the Web-Quest design. The first cohort designed WebQuests dealing with historical dilemmas related to World War II and the second cohort designed WebQuests addressing a dilemma related to the Kibbutz ideology.

Method & Tools

The competition activities were an integral part of the courses; participation as assessors was mandatory and credited. The actual grades for the artifacts were given only by the instructor and students' assessments and ranking did not influence it. The specific activities and their web-based implementation are detailed in the next section. Following the experience students answered a questionnaire containing open questions and Likert type questions reflecting on their feelings and attitudes related to participating in the activity. The Likert type items asked students to rate the following statements: "the fact that my artifact was rated by my peers: stressed me, paralyzed me, made me put more effort into the project, made me conduct more improvement trials, ended up improving my artifact", "peers' assessments seem valid to me", "I would like to have more such competitive-like activities".

The Web-Based Competition: Design and Enactment

The online competition activities explored in this study were conducted with CeLS (Collaborative e-Learning Structures), a web-based environment for designing and enacting collaborative online activities (Ronen & Kohen-Vacs, 2011). CeLS' unique feature is the ability to design activities that selectively use learners' artifacts from previous stages according to various Social Settings (e.g., one team accesses another team's project, a whole class gives improvement ideas to one team, etc.). The Social Structures determine the social nature of artifacts (as individual or group products) and which and how many artifacts would be presented to each participant for further interaction. This feature is exploited in order to design the competition activities and to facilitate their enactment in a real setting. The system offers content free templates and a searchable repository of sample activities that were implemented with students. Teachers can explore these resources and adapt them to suit their needs or create new activities from basic building blocks.

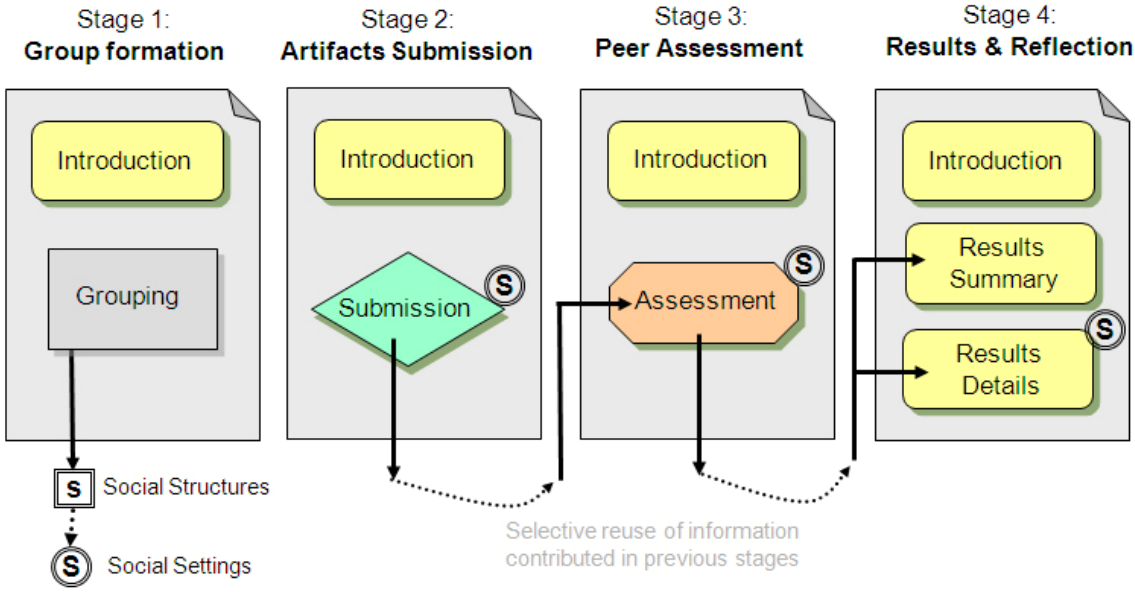

Figure 1: The general structure of a team competition activity implemented with CeLS.

The general structure of the competition activity used in this study consists of four stages (Figure 1). Stages 1-3 are performed asynchronously during a period of about 3 weeks. Stage 4 serves for a summative class discussion and may be followed by additional asynchronous activity of commenting on the results and reflecting on the activity (this additional activity is not presented in Figure 1).

All stages start with an Introduction presenting the relevant instructions for the stage.

Stage 1 – Group formation (1-2 days): Students self enroll to project teams according to the teacher's definition, for instance, teams can consist of min 2 and maximum 3 students. These teams define the Social Structures that are later used by the system to control the data flow during the enactment, defining which and how many artifacts and assessments will be presented to whom.

Stage 2 – Artifacts preparation and submission (2-3 weeks): Provides a dedicated interface for the artifacts' submission. The submission interface is adapted by the teacher to suit the specific requirements of the activity: in the posters competition, the interface invited students to summit picture files (JPG limited to 300kB), and in the WebQuest competition the title of the WebQuest and a proper link to a website. The artifacts submitted can be individual or group products, as defined by the Social Settings. In our case the artifacts were group products. This definition would enable either of the group members to submit the artifact and update the submission until the stage deadline.

Stage 3 – Peer Assessment (4-7 days): Group artifacts are presented anonymously to peers for individual evaluation. The teacher defines the number of artifacts allotted to each participant while the system automatically takes care of a uniform distribution so that each artifact would be subjected to a similar number of evaluations. If the activity involves assessing many artifacts (as in the Poster competition) or if the artifacts are complex and their assessment requires considerable effort (as in the WebQuest competition), it would be advisable to restrict the load and present each participant with a limited number of artifacts. Therefore, in the Poster competition each student was asked to assess 8 artifacts while in the WebQuest competition only 5 artifacts were assessed by each student. The interface in our competition activities was adjusted so that each assessor had to provide an overall grade and verbal justifications and explanations for this grade, as demonstrated in the example in Figure 2(a). If an activity would require a more detailed evaluation addressing various criteria, the interface could provide a questionnaire or a rubric.

Stage 4 – Results & Reflection: The competition overall results are presented to all, as shown in Figure 2(b). In addition, each participant is presented with the assessment details (specific grades and justifications) for his own artifact only, presented anonymously (See Figure 4).

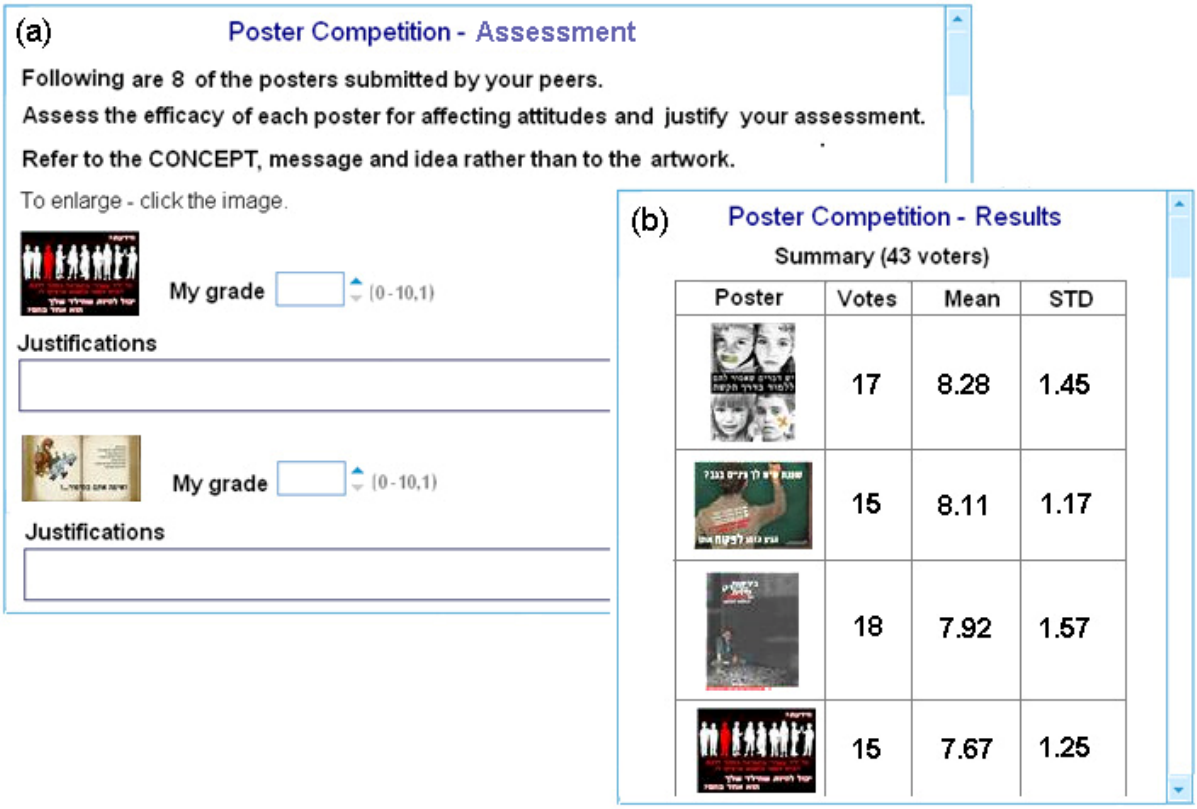

Figure 2: Sample screens from the Poster Competition. (a) Stage 3 (b) Stage 4.

Findings

First we will present data regarding the quality and trustworthiness of peers' assessments and to what extent they feel their peers judged their artifact fairly. Then we will present students' attitudes toward competing and being assessed by peers and their perception of the impact of the competition approach on the quality of their artifacts.

Students as Assessors

Table 1 presents the correlations between students' mean ratings of artifacts and the instructor's independent ratings in each of the five groups. Similar to Kali & Ronen (2008) findings, students' mean ratings seem to be valid and correlate significantly with the instructor's grades.

Table 1: Correlations between peers' and instructor's ratings.

Activity	# of Artifacts	Min. Peer Evaluations per Artifact	Pearson's correlation (r)	Statistical significance (p)
Poster Competition 2009: Open education	20	14	0.82	$p < 0.001$
Poster Competition 2010: Bullying	24	18	0.49	$p < 0.02$
Poster Competition 2011: Multitasking during lectures	16	15	0.86	$p < 0.001$
WebQuest Competition 2009: world war II dilemma	24	8	0.68	$p < 0.001$
WebQuest Competition 2010: Dilemma related to the Kibbutz ideology	19	10	0.70	$p < 0.001$

There is some difference between the poster groups' correlations and the WebQuest groups' correlations presented in Table 1. The higher correlation between students and instructor in the Poster competitions is probably due to the fact that the artifact is less complex and less multi dimensional then the WebQuest one. In the WebQuest activity the assessment process was much more demanding. As a result some students were biased by salient features (such as interface and visual design) rather than assessing factors such as the pedagogical value of the WebQuest, resulting in a lower correlation between students' and instructor's assessments. Figure 3 presents an example of instructor's and peer grades for WebQuest 2010 (19 teams' artifacts were submitted). In addition to the significant overall correlation one can notice that for some of the artifacts (10, 11, 16, 17, 19) the instructor's grades were considerably lower than peers grades.

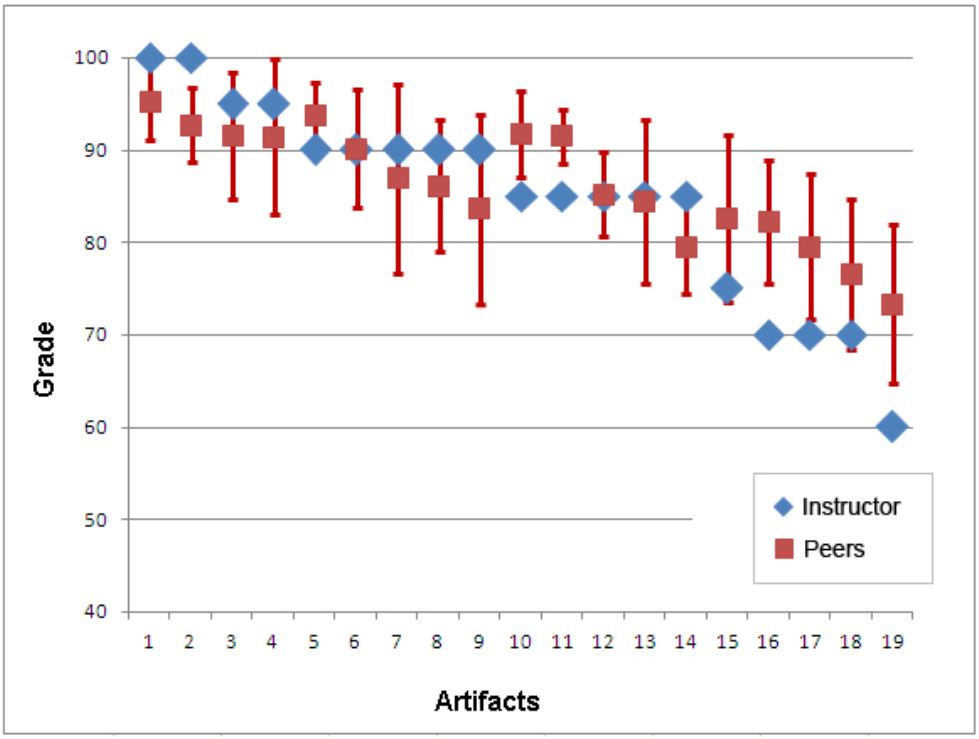

Figure 3: Instructor and peer grades for WebQuest Competition 2010

Higher ranked (by peers and instructor)		Lower ranked (by peers and instructor)	
			
Peer grade	Justifications	Peer grade	Justifications
10	Great idea ! The basic math skills that kids may not be able to learn because of bullying. The use of black-white pictures makes it more dramatic.	5	I did not understand the concept. The girl is smiling and looks happy does - not like a victim. It is not clear who is the target audience of this poster. The message is hidden and complex.
10	Excellent! There is a good fit to adult audience: The usage of very familiar and prototypical mathematical symbols activates a whole set of memories, associations and emotions related to school life. The usage of suffering children effectively addresses emotions without creating excessive fear.	7	There is a strong appeal to cognition here. The viewer has to add his own meaning – it forces him to think and take a stance. The smiling girl gives the illusion that everything is OK. However adults should be more sensitive and observant and realize that something is wrong.
9	The message is so strong - it simply imprints itself into your brain both visually and conceptually. Very touching. An effective appeal to emotions of empathy. The eyes of the kids actually talk to you. I took one point off since the message talks about violence in general and not Bullying in particular.	7	I love the concept and the design. I happened to see the brochure so I know that the related picture (missing in the poster) is that of a boy inside the garbage can. However if I wouldn't have seen it - I am not sure I would have understood the poster.

Figure 4: Examples of posters and few sample peer assessments.

Students' comments to artifacts were interesting, non-repetitive, and provided an enriching and insightful analysis of the artifacts. It seems that any feedback given only by the instructor could not provide comparable intellectual and emotional impact (see examples in Figure 4).

Most students in all five groups (about 85%) felt that peer assessments to their own artifacts were valid and fair. No significant correlation was found between the appreciation of peer grades' va-

lidity and the actual grades granted by the peers, meaning that this view was shared also by students whose artifacts were judged less favorably by their peers.

Competition as an Instructional Strategy – Student's Views

The analysis of the three groups of 1st year students' and the two groups of 2nd year students' responses to the reflective questionnaire and interviews revealed very similar distributions, therefore we shall refer to them as a whole (N=176). Most students felt that the awareness to the fact that their artifacts would be exposed and assessed by peers resulted in a better product (Table 2).

Table 2: Perceived impact of the awareness that the artifacts would be assessed by peers on artifacts' quality (N=176).

Perceived impact on artifacts' quality (%)				
None	**Little**	**Some**	**Large**	**Very large**
15	13	43	21	8

Only few students (4%) reported that the competition was somewhat "paralyzing" resulting in a detrimental effect upon their artifacts.

As could be expected, motivation attributed to the competition (items such as "the fact that my artifact was rated by my peers made me put more effort into the project") was significantly correlated with the perception of positive effect on products' quality ($r=0.75$ $p<0.001$). The more interesting finding is related to the perception of stress caused by the competition activity (based on the item: "the fact that my artifact was graded by my peers stressed me"). The estimation of effort devoted to the creation of the artifacts was significantly correlated with the perception of stress ($r=0.23$ $p<0.05$), meaning that students who admitted to being more stressed also felt that they have devoted more time and effort to the activity. The beneficial effect of "some stress" is demonstrated in Table 3 that presents the student's perceptions of the competition activity as motivating and as stressing.

Table 3: Student's perceptions of the competition as a motivating vs. stressing activity (N=176).

		Motivation (%)			
		none	**some**	**much**	Total
Stress (%)	**none**	**5**	**20**	**20**	45
	some	**2**	**26**	**23**	51
	much	**1**	**2**	**1**	4
	Total	8	48	44	100

Even though most (60%) would favor using competition activities in academic courses, in their detailed comments many recommended not to "overuse" this strategy and to restrict it to once in a semester in order not to impose an "exaggerated" workload. The quantitative aspects were supported by students' written comments. Following are few examples of students' opinions regarding peer judged competition as an instructional method:

Positive opinions:

- It is very motivating. It made me put lots of effort. I think that without the competitive factor I wouldn't have achieved such a success in this WebQuest activity. In addition the CeLS environment allowed us all to see each others' products, which is very nice for comparing and learning.
- The number of WebQuests we had to assess (5) was just right. I would not ask students to assess more then that. I believe competition is always a good idea. The fact that the leading products were presented and discussed in class made me feel really good after all the effort I have put in it.
- I am a competitive type so this method really helped me to achieve a meaningful product. I was enriched by viewing the elaborated products of my peers. To summarize, it was fun and educative.

Ambivalent opinions:

- I think the competitive activity is useful, efficient and contributing as long as a rubric is provided and the grading process is led by it. In this WebQuest activity we were encouraged to use a rubric. According to the competition results, it seems that not everyone used it - so there isn't enough uniformity in the grades given by peers and in some cases there weren't sufficient explanations to support assigned grades.
- I think that to some extent the competition did stimulate interest and encouraged teams to produce better WebQuests – yet, personally I believe that it is not always good to conduct such competitions since it might create tensions between class members, create uncomfortable situations, or unreliable results.
- I don't like so much competitive activities. Working in a primary school I saw cases where students gave up in advance, since they thought they don't have a chance. On the other hand – I think that from time to time, such an experience could be a fun and refreshing.
- Competition could paralyze people with low self-confidence – yet, with right team work such a problem might be less dominant. I believe in competition, believe it motivates, and produces higher quality products. Of course one shouldn't exaggerate and put people into too much pressure.
- Competition is a good yet problematic method. It was difficult for me to assess close friends from our class. In addition, competitive students would not want to give high grade to others that might surpass them. In a small and cohesive class as ours - it is hard to critique others.

Negative opinions:

- Some people need to learn how to provide feedback to others – and the instructor needs to stress it.
- After reading the feedback given to our WebQuest I was really upset. I realized that people drastically punished us for criteria that weren't relevant. It seems that people didn't realize what the purpose of the activity was. Some groups created a fully functioning web site rather then a prototype. As a result feedback focused on usability and visual design aspects rather then the criteria defined by the rubric provided.

- The problem with competition is that it puts pressure on those who are highly anxious. I am sorry that in our class (1st year, poster project) anxiety is more salient then healthy competition. But maybe it is only our class and when time passes it will change.

One can see the competitive activity raised some intense emotions. Most students loved it while some, especially in the 1St year, were skeptical about their peers' feedback and worried about augmenting the anxiety level in class. It seems that most of the students felt that the activity was refreshing and fruitful yet shouldn't be implemented too often.

Discussion

The findings support previous reports which provide evidence that peer assessments are trust worthy, reliable, and in many cases highly correlate with instructors' assessments (e.g., Kali & Ronen, 2008). Students' verbal comments to their peers' artifacts in our study demonstrate the emotional and intellectual advantage of feedback provided from multiple perspectives as compared to feedback provided exclusively from the instructor. Students' comment to peers' artifacts seem to be enriching, interesting, stimulating, and honest. Despite the concerns of few, most students reported they trusted their friends' feedback, and this was true also for students who did not do so well.

Most students believe that the awareness to the fact that their products would be assessed by their peers boosted their motivation and as a result they submitted better artifacts. The fact that the experience of stress was positively correlated with effort invested supports the famous inverted U theory (e.g., Muse, Harris, & Feild, 2003) which claims that moderate amounts of stress improves performance. However, our data suggests that some students might experience intense stress related to peer ranking and competition.

The academic grading system is based on competitive sorting. Many believe that competition is detrimental to learning and to intrinsic motivation and call for the minimization of its effects by means of educational strategies such as collaborative learning (e.g., Kohn, 1992). Do competitive learning activities augment the harmful effects of grading and competitive sorting? Our quantitative and qualitative data supports studies that claim that the team competition is an effective and engaging experience (Fu et al., 2009; Ke & Grabowski, 2007; Slavin, 1980; Slavin et al., 1984; Yair, 2006). Recent motivation theories (Covington & Wiedenhaupt, 1997) argue that intrinsic and extrinsic motivations are two independent dimensions (they suggest a quadripolar model rather than a bipolar one). Thus, despite the fact that competition factors might increase extrinsic motivation, one might still be intrinsically involved in a task, as long as the task is authentic and challenging. One can be stressed yet intrinsically motivated at the same time. The study mentioned above (Yair, 2006), which suggests that many adults retrospectively describe project-based team competitions as key educational experiences that had a lasting impact on their life-course, strongly supports this point.

Nemerow (1996) suggests that as long as competitions are fun and more similar to play rather than work (Covington & Wiedenhaupt, 1997) intrinsic motivation will be preserved. In a study applying both competitive and noncompetitive games, students were surveyed to find out how they felt about the games and what they learned from them. Results indicated that competitive games helped students improve self-esteem, peer relationships, and learning, yet, the students described the competition as motivating but also producing pressure. The competitive learning experience in our study seemed to endorse a playful climate and to intrinsically engage most of our students and caused many of them to believe they improved their performance. Other higher education studies which experimented with similar, challenging, fun, team competition activities support this notion (e.g., Casile, & Wheeler, 2005; Corner et al. 2006; Cramer & Kurten, 2005; Kinzie et al. 1998).

Conclusion and Recommendations

The fact that the team competition activities energized students in our study and made them believe that it improved their products might indicate that when the project is challenging, and when a favorable social climate is created, most learners might enjoy and benefit from the 'public' exposure and competitive situation involved with peer ranking and assessments. The rich and diverse nature of multiple perspective feedback seems to have potential for augmenting learning processes and meta-cognitive self-assessment abilities (White & Frederiksen, 2000). Teachers in higher education should consider using more often such strategies in any discipline where the creation of original artifacts is relevant. As long as they succeed to offer students a challenging project and create a playful, psychologically safe climate, the chances are that most students will get intrinsically involved, enjoy the experience, and as a result of assessing others' work, become more reflective about their own learning. Using a web-based environment such as CeLS eliminates most of the burden involved in planning and carrying out peer assessed competitions. Since the environment takes care of the logistic hassles, it increases the chances that instructors will enjoy the experience as well.

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