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Characteristics of an innovative learning environment according to students' perceptions: actual versus preferred

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Abstract An innovative learning environment is the current outcome of the constructivist approach, the essence of which is co-construction of knowledge in an Information and Communication Technology (ICT) environment. We examined how Israeli students perceived 10 characteristics of their classroom learning environment—student cohesiveness, teacher support, involvement, task orientation, investigation, cooperation, equity, differentiation, computer usage and young adult ethos. Particular foci were students' perceptions of the actual state of their learning environment compared with the preferred state, and which characteristics predicted students' cooperation. Participants were 1022 students in 33 classes from 12 computerised elementary and middle schools in Israel. Data were collected using the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI). Results indicated a gap between the actual and the preferred states for all characteristics, although the scope of these gaps differed between elementary-schools students and middle-school students for certain characteristics. Structural equation modelling (SEM) analysis indicated that nine characteristics of the innovative environment in both actual and preferred states were related to cooperation, with these relations being primarily direct with the exception of teacher support and differentiation which had an indirect influence. Teacher support was mediated through student cohesiveness, involvement, equity and young adult ethos, whereas differentiation was mediated through investigation. Evaluation of the innovative learning environment might lead to better insights regarding the behaviours and needs of twenty-first century students in Israel's education system. These insights could advance constructivist processes and teaching methods and bring the students to effective cooperative learning in an innovative learning environment.

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Introduction

The technological changes of the twenty-first century have not overlooked the education system. Technology has created exciting new stimuli and learning situations that arise from the interaction between pedagogy and technology (Fullan and Langworthy 2013). Indeed, in recent years, Israel's Ministry of Education has attempted to integrate a variety of digital technologies to create meaningful learning environments that focus learner development of twenty-first century skills (Ministry of Education 2016). These skills include the development of creativity and innovation, critical thinking and problem solving, as well as communication and cooperative skills (Partnership for 21st Century Skills 2013). An online, technology-rich learning environment invites a different kind of learning both within and outside the classroom. This environment enables attainment of desired scholastic and educational goals, given its potential to effect a meaningful change in teaching–learning processes (Law 2008).

The innovative constructivist learning environment

The concept of 'learning environment' has many definitions and it relates to the sociological, psychological and pedagogical contexts of the teaching–learning process and affects learners' attitudes and achievements (Ju-Sen and Chaoyun 2014). In a constructivist learning environment, the activities represent the complexity of the real world, invite construction of content and context-dependent knowledge, and encourage reflective thinking (Jonassen 2009).

Research on learning environments is diverse and encompasses many different (Fraser 2014). The current study applied Fraser's approach, which defines the learning environment as an atmosphere, a tone, a climate in the classroom pertaining to the behaviour of the students and the teacher and enabling constructivist teaching–learning processes (Fraser et al. 1996). Fraser (1990) developed a student-focused questionnaire to assess the learning environment—the Individualised Classroom Environment Questionnaire (ICEQ). He later refined it to create the What Is Happening In this Class? (WIHIC) questionnaire, which is better suited to evaluating the environment in a constructivist classroom (Fraser 2007). In his studies, Fraser (1994) identified the *seven* distinct but intertwined characteristics below that compose the advanced, innovative constructivist learning environment and involve psychosocial, intrapersonal and interpersonal dimensions (Boy and Pine 1988; Magen-Nagar and Steinberger 2014).

Student cohesiveness

Cohesiveness means a lack of contradiction or conflict within a particular system (Kaniel 2010). Thus, student cohesiveness refers to the interpersonal aspect and describes feelings of belonging towards group members and how the individual relates to the group as a unit acting in cooperation and mutual commitment.

Teacher support

This is the extent to which a teacher shows interest in the students, is warm, friendly and helpful. The nature of such teacher–student relations impacts on teaching practices, peer learning and student involvement in the lesson (Hattie 2009) and contributes to a positive and nurturing learning environment (Kaniel 2010).

Student involvement

This is defined as 'being an active student' in class and not just a passive listener (Schmidt et al. 2007). The involvement of students in learning activities gives them independence and responsibility in how they manage their learning (Kaniel 2010) and contributes to the acquisition of social skills and improves the atmosphere in the class and in the school (Shachar 2011).

Task orientation

This characteristic emphasises the motivational–emotional aspect of the student within the learning environment. It relates to the student's ability to show interest in the learning task and the willingness to make an ongoing effort to complete it successfully (Michalsky and Kramarski 2008). Shachar (2011) mentioned several factors that might augment a student's task orientation, including having a choice of learning topic and being shown the assessment criteria ahead of time.

Investigation

This is defined as a variety of skills required to conduct an investigative process, such as asking questions and problem solving (Wiggins and McTighe 1998). Investigative processes have cognitive, motivational and social benefits (Shachar 2011), with the student discovering knowledge via cooperation while the teacher mainly provides opportunities for learning (Strong et al. 2003).

Cooperation

This characteristic describes cooperation between members of a group in the learning process in order to take full advantage of the learning abilities of each member (Yoshida et al. 2014). Cooperative learning has five interlinked components: (1) positive mutual dependence; (2) personal accountability; (3) useful interaction; (4) social skills; and (5) a group process (Johnson et al. 2014). Cooperation requires mutual respect, interaction and mediation among the learners (Schmidt et al. 2007). Moreover, it leads learners to accept responsibility and develop an inner locus of control. It also helps the construction and understanding of knowledge and contributes to social relations within the class (Hattie 2009; Kaniel 2010).

Equity

This refers to a teacher's fair treatment of the students, stressing equality with no bias or preference for one student over another (Jonassen 2009). Equity is expressed in providing

an opportunity for cooperative and investigative learning based on democratic relations among the students themselves and between them and their teacher (Strong et al. 2003).

The development of educational technologies has changed the constructivist learning environment in which the student has to develop life skills as the foundation for the future of many occupations and social issues (Fraillon and Ainley 2010). The computer has become a learning environment rich with options that help students to obtain information and introduces them to thought-provoking stimuli. It also makes them more active in developing skills of asking questions, searching for and organising information, authentic processes of investigation, problem solving and cooperative work (Bower et al. 2010). Thus it offers many opportunities for innovative constructivist learning.

There is an expectation that this kind of learning environment will lead teachers to adopt student-centred methods that apply these essential learning skills (Ertmer and Ottenbreit-Leftwich 2010). Indeed, education systems have been adjusting curricula and teaching–learning strategies to the new technologies (Aristovnik 2012; Halverson and Smith 2010).The introduction of technological changes into the classroom and into the students' lives generally has required a reexamination of the research tools used for examining the learning environment. Aldridge et al. (2004) believe that the ICT-integrated constructivist learning environment, known as an 'innovative learning environment', contains all the components of the abovementioned constructivist learning environment. However, the three interlinked components must be added to this ensemble.

Differentiation

This refers to differential treatment by the teacher to cater to the varying needs of different students (Hattie 2009). An ICT-integrated learning environment gives access to a range of content and alternative assessments, pedagogical flexibility, and the option of applying a range of alternative teaching–learning methods and activities adapted to the abilities and needs of each student (Kirkland and Sutch 2009).

Computer usage

This is currently perceived to mean computer and information literacy—the individual's ability to use the computer for investigation, creation and communication in order to work and share at school, at home, in the workplace and within the community (Fraillon and Ainley 2010). Computer and information literacy is one of the twenty-first century skills and is also a means of mastering additional twenty-first century skills (McGhee and Kozma 2000).

Young adult ethos

This is the teacher's perception of the student as a responsible young adult: a mindset that recognises students' ability to think critically, consider alternatives, anticipate the outcome of their choices, prevent undesirable outcomes and recognise the consequences of their actions. A teacher who treats students in these ways educates them to conduct themselves wisely and be responsible for themselves and for others in their class (Abu Hussain and Gonen 2013). These components are essential for adapting to the rapid changes in the information age (Partnership for 21st Century Skills 2013).

The research context

According to research findings, students would prefer a higher level of all the characteristics of the innovative learning environment than that which they currently perceive to be present (Dorman 2008). Aldridge et al. (2013) explain that the gaps reported by students between actual and preferred learning environments could stem from their own technological devices which allow them to experience meaningful learning that strengthens their intrapersonal and interpersonal facets. Thus they can expect the school's routine learning environment to be the same. They added that, because the way in which students perceive the learning environment might affect their motivation to learn and their future behaviour (Afari et al. 2013; Ju-Sen and Chaoyun 2014), more positive environments lead to greater students' motivation, more effective learning processes and higher achievements (Dorman 2009; Pickett and Fraser 2009). If that is so, the learning process and its outcomes might improve considerably if schools develop the learning environment components and adapt them as best they can to ensure students' successful functioning in the twenty-first century (Fraser 2014).

The current study sheds light on the component of cooperation that is typical of innovative twenty-first century pedagogy. It is vitally important to develop cooperative learning processes, especially because they involve social, intellectual and emotional aspects of the changing reality in which students work and study (Shachar 2011). Moreover, teaching cooperatively emphasises innovative learning environments in which the learning process is adapted to the heterogeneity of the students rather than to the outcomes of the learning. According to theoretical and research literature, the learning environment components proposed by Fraser are the basis of successful cooperative learning (Gillies 2016). Hence, the current study examined how students perceived their actual innovative learning environment in comparison with a preferred one, as well as the contribution of the characteristics of an innovative learning environment to the prediction of cooperation in the actual and preferred states.

Research hypotheses

1. According to students' perceptions, the level of innovation of the preferred learning environment will be higher than for the actual learning environment.
2. According to students' perceptions, the higher the level of the actual learning environment (student cohesiveness, teacher's support, students' involvement, task orientation, investigation, equity, differentiation, computer usage and young adult ethos) the stronger their cooperation will be in both the actual and preferred states.

Research method

Participants

The study involved 1022 students from 33 classes in 12 computerised schools in Israel, with the following student distribution: Grade 4–19.6%, Grade 5–20.2%, Grade 6–19.8%, Grade 7–11.6%, Grade 8–15% and Grade 9–13.9%. Of these students, 507 (49.6%) were males and 515 (50.4%) were females. Only 27 (2.6%) of all students reported not having a computer at home.

Research tools

The research questions were examined using the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) questionnaire (Aldridge et al. 2004), which is based on a questionnaire that assesses the student-focused learning environments using the Individualised Classroom Environment Questionnaire (ICEQ) (Fraser 1990). Scales were added to the TROFLEI questionnaire to explore the attributes of the innovative learning environment in actual and preferred states (Aldridge et al. 2004). The questionnaire included 80 statements divided into 10 scales: student cohesiveness, teacher's support, students' involvement, task orientation, investigation, cooperation, equity, differentiation, computer usage and young adult ethos.

For the purposes of this study, the original questionnaire was translated from English into Hebrew using the accepted research practice of translation, namely, back translation (Afari et al. 2013) and its items were reformulated to suit the Israeli student population. Minor changes in wording were made, while carefully adhering to the authentic structure and parameters of the questionnaire, and the entire process was validated by referees and professional translators.

In order to examine the validity of the structure of the questionnaire, we conducted a principal components factor analysis with Varimax rotation limited to 10 factors. This factor analysis was replicated for the actual and preferred states. The results showed that, for both states, items could mostly be grouped into the parameters of the original questionnaire of Aldridge et al. (2004). The percentage of the variance explained in the actual state was 59.86% and in the preferred state was 60.41%. The reliabilities of the entire questionnaire was $\alpha = 0.97$ in both actual and preferred states, and the reliability range of its scales was between $\alpha = 0.83$ and $\alpha = 0.95$. Table 1 shows descriptive information for the 10 TROFLEI scales.

Students were asked to rank the degree of frequency of the situations occurring in class (the actual situation) and the preferred frequency with which such situations would occur in class (the preferred situation). Items were measured using a 5-point Likert scale with responses ranging from 'hardly' (1) to 'almost always' (5). The level of innovation was calculated for each student according to the mean score of the answers to the questionnaire items.

Research process

During the 2015–2016 school year, students were asked to complete the questionnaire online using Google Forms in the school computer laboratories, with their anonymity and privacy assured. The time needed to complete the questionnaire was about 30 min.

Findings

In order to answer the first research hypothesis concerning whether the preferred level of the innovative learning environment is higher than for the actual state, one-directional repeated-measurement variance analyses were performed, taking into account the educational level (elementary/middle school) (Table 2).

Table 2 reveals significant gaps between the actual and preferred states for both groups of students for each of the learning environment parameters, with the preferred state being

Table 1 Descriptive information for 10 TROFLEI scales

Environment scale	List of items	Scale description	Explained variance (%)		Cronbach α	
			Actual	Preferred	Actual	Preferred
Student cohesiveness	1–8	The extent to which students know, help and are supportive of one another	5.87	5.11	0.86	0.85
Teacher support	9–16	The extent to which the teacher helps, is friendly, trusts and is interested in students	6.60	5.99	0.89	0.85
Involvement	17–24	The extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class	3.72	4.46	0.86	0.86
Task orientation	25–32	The extent to which it is important to complete activities planned and to stay on the subject matter	6.71	7.30	0.89	0.92
Investigation	33–40	The extent to which skills and processes of inquiry and their use in problem solving and investigation are emphasized	6.49	6.99	0.91	0.92
Cooperation	41–48	The extent to which students cooperate rather than compete with one another on learning tasks	5.86	6.02	0.89	0.87
Equity	49–56	The extent to which students are treated equally by the teacher	7.96	6.72	0.95	0.93
Differentiation	57–64	The extent to which teachers cater to students differently on the basis of ability, rates of learning and interests	7.34	4.62	0.83	0.83
Computer usage	65–72	The extent to which students use their computers as a tool to communicate with others and to access information	3.07	5.55	0.86	0.87
Young adult ethos	73–80	The extent to which teachers give students responsibility and treat them as young adults	6.79	7.09	0.90	0.88

at a higher level than the actual state. The effect of the interaction between the stage of education and the gap between the actual and preferred states was significant for four parameters: teacher support, task orientation, cooperation and computer usage. In other words, the gaps found for these parameters between actual and preferred states were different for elementary schools and for middle schools. On the other hand, the gaps between actual and preferred states for the remaining parameters of the learning environment were similar for both stages of education.

In order to examine the second research hypothesis, that the characteristics of the actual learning environment predict the level of cooperation, two path analyses were performed—the first for the actual state and the second for the preferred state. First the correlations between the characteristics of the innovative learning environment in its actual and preferred states were examined with a Pearson coefficient matrix.

Table 2 Results of the one-directional repeated-measurement variance analyses

Scale	Elementary schools ($N = 608$)				Middle schools ($N = 414$)				Gap effect	Stage × gap
	Actual		Preferred		Actual		Preferred		$F_{(1,\ 1020)}$	$F_{(1,\ 1020)}$
	M	SD	M	SD	M	SD	M	SD		
Student cohesiveness	4.15	0.67	4.52	0.61	4.04	0.78	4.39	0.72	426.99***	0.61
Teacher support	3.65	1.01	4.19	0.81	3.45	1.05	4.13	0.85	492.99***	6.58**
Involvement	3.60	0.90	4.12	0.83	3.47	0.96	3.95	0.92	511.81***	0.96
Task orientation	4.29	0.73	4.69	0.60	4.11	0.85	4.57	0.75	561.03***	2.85*
Investigation	3.34	1.07	3.85	1.13	2.86	1.11	3.32	1.19	447.41***	1.30
Cooperation	4.06	0.84	4.38	0.77	3.92	0.97	4.16	0.95	226.73***	4.53*
Equity	4.17	1.00	4.61	0.73	4.06	1.12	4.52	0.84	256.91***	1.05
Differentiation	2.98	1.01	3.62	1.01	2.47	0.98	3.22	1.10	535.40***	3.58
Computer usage	2.96	1.09	3.59	1.11	2.62	1.06	3.10	1.15	434.04***	7.42**
Young adult ethos	4.22	0.88	4.59	0.67	4.17	0.96	4.48	0.81	230.67***	1.27
All variables	3.74	0.63	4.22	0.58	3.52	0.72	3.98	0.68	879.64***	0.05

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Tables 3 and 4 show the Pearson correlations between the 10 characteristics of the innovative learning environment (among themselves). In the actual and preferred states, there were low to high positive correlations among the learning environment characteristics. Moreover, the averages of the parameters in the preferred state were higher than for the actual state.

Testing the structural model and confirmation of the two research hypotheses

In order to test the contribution of variables of the innovative environment to the prediction of cooperation as reported by students, a path analysis model with Structural Equation Modeling (SEM) was proposed, using the statistical software Analysis of Moment Structures (AMOS) 22.0 (Arbuckle 2013). This software allows simultaneous examination of variables and their relationships and improves the examination's reliability through reference to the Measurement and Structural Models; thus the analysis can support or disprove the foundation of the theory upon which the research is based.

Construction of the influences between learning environment characteristics was performed on the basis of the literature review and the results of the Pearson coefficients. The first stage in SEM is assessment of the measurement model via testing the measures that indicate its fit to the model. The four measures of χ^2, RMSEA, NFI and CFI were used to test the model's best fit to reality (Bentler and Bonett 1980; Kline 2010). Table 5 shows the fit measures of the models for predicting cooperation.

The results in Table 5 show that the measurement of all terms was valid, thereby strengthening the theoretical basis guiding the choice of the different parameters for the actual and preferred states. Additionally, the findings of the measurement models indicate a good fit between the model and the research data.

Table 3 Pearson correlation matrix between the research variables, in the actual state ($N = 1022$)

	Scale	Correlations									M	SD
		2	3	4	5	6	7	8	9	10		
1	Student cohesiveness	0.441**	0.604**	0.454**	0.343**	0.570**	0.357**	0.226**	0.267**	0.437**	4.10	0.72
2	Teacher support		0.589**	0.436**	0.431**	0.398**	0.618**	0.392**	0.387**	0.486**	3.57	1.03
3	Involvement			0.567**	0.586**	0.548**	0.485**	0.343**	0.413**	0.522**	3.55	0.92
4	Task orientation				0.506**	0.508**	0.543**	0.265**	0.335**	0.582**	4.21	0.78
5	Investigation					0.472**	0.372**	0.488**	0.546**	0.372**	3.14	1.11
6	Cooperation						0.423**	0.320**	0.434**	0.497**	4.00	0.90
7	Equity							0.336**	0.323**	0.668**	4.13	1.05
8	Differentiation								0.633**	0.305**	2.77	1.03
9	Computer usage									0.358**	2.82	1.09
10	Young adult ethos										4.20	0.91

** $p < 0.01$

Table 4 Pearson correlation matrix between the research variables, in the preferred state ($N = 1022$)

	Scale	Correlations									M	SD
		2	3	4	5	6	7	8	9	10		
1	Student cohesiveness	0.574**	0.622**	0.535**	0.380**	0.514**	0.444**	0.240**	0.290**	0.458**	4.47	0.66
2	Teacher support		0.615**	0.477**	0.414**	0.465**	0.480**	0.309**	0.376**	0.442**	4.16	0.82
3	Involvement			0.572**	0.589**	0.582**	0.480**	0.320**	0.437**	0.497**	4.05	0.87
4	Task orientation				0.466**	0.527**	0.685**	0.242**	0.295**	0.648**	4.64	0.67
5	Investigation					0.526**	0.430**	0.419**	0.571**	0.430**	3.63	1.18
6	Cooperation						0.556**	0.363**	0.468**	0.520**	4.29	0.85
7	Equity							0.312**	0.332**	0.687**	4.57	0.78
8	Differentiation								0.625**	0.348**	3.45	1.07
9	Computer usage									0.401**	3.39	1.15
10	Young adult ethos										4.55	0.73

** $p < 0.01$

Table 5 Fit measures of the models for predicting cooperation

Fit measures	Recommended levels of fit	Value of the measure actual	Value of the measure preferred
χ^2	n.s. at $p < 0.05$	38.39***	32.81**
χ^2/df	<0.5	2.399	2.050
CFI	>0.90	0.996	0.997
NFI	>0.90	0.992	0.994
RMSEA	<0.08	0.037	0.032

** $p < 0.01$; *** $p < 0.001$

Next, the structural model was tested in order to classify the interactions between variables. The same model was tested in the two states—actual and preferred. Figure 1 represents the path analysis. The explained variances (R^2) are presented in the figure, while standardised coefficients (β) are presented in Table 6.

Figure 1 shows that similar results were obtained, with explained variance percentages, for the endogenous variables in the actual and preferred states. Half of the cooperation variable is explained by the variables of student cohesiveness, involvement, investigation, task orientation, equity, computer usage and young adult ethos (actual 48%; preferred 50%). The most obvious difference between the actual and preferred states was found for the variables of student cohesiveness, which was explained by teacher support, equity and young adult ethos (actual 26%; preferred 39%), and task orientation, which was explained by student cohesiveness, equity, computer usage and young adult ethos (actual 43%; preferred 57%).

Table 6 shows differences in the direct and indirect influences between the actual and preferred states. In the actual state, the direct influences were greater than for the preferred state. In terms of predicting cooperation, the direct influences between the variables of investigation and computer usage, on the one hand, and cooperation, on the other, were found to be weakly significant. In the actual state, the influence of student cohesiveness on cooperation was of medium significance while, in the preferred state, it was significant but low. In contrast, in the preferred state, the influence of equity on cooperation was of medium significance while, for the actual state, the influence was nonsignificant. For the actual state, the influence of task orientation on cooperation was significant but low while, for the preferred state, the influence was nonsignificant. One can see that, for the preferred state, the influence of involvement on cooperation was of low significance while for the actual state it was nonsignificant. The influence of computer usage on cooperation for both actual and preferred states was found to be significant to the same low degree.

In terms of indirect influences, for both actual and preferred states, involvement mediated between teacher support and investigation and that investigation mediated between involvement and cooperation. Likewise, for both actual and preferred states, task orientation mediated between young adult ethos and investigation, and investigation mediated between task orientation and cooperation. Furthermore, in both actual and preferred states, teacher support mediated between computer usage and young adult ethos more strongly than the direct influence. In the preferred state, equity mediated between young adult ethos and task orientation more strongly than the direct influence. Finally, in both actual and preferred states, computer usage influenced differentiation highly significantly, teacher support to a moderate degree on and involvement to a low degree.

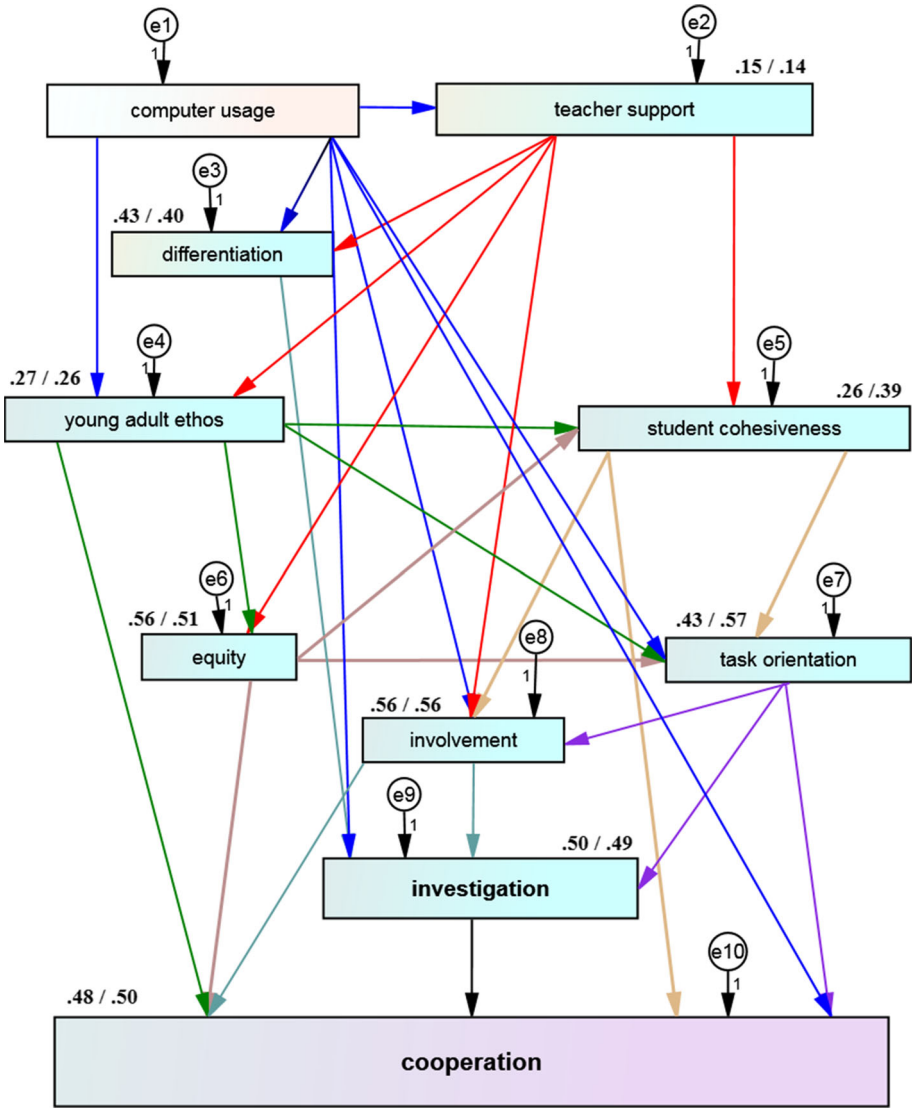

Fig. 1 Path analysis for actual and preferred states

Discussion and conclusions

In the twenty-first century, learning environments are based on technology and provide students with opportunities to investigate in-depth content that goes beyond disciplines, solve problems independently, create meaningful cooperation and cultivate and challenge thinking (Mishra et al. 2013). The current study examined differences between the actual innovative learning environment and a preferred one, and the contribution of environment characteristics to the prediction of cooperation in the actual state compared with the preferred state according to students' perceptions. The study showed quite clearly that

Table 6 Direct and indirect influences on actual and preferred states

Direct and indirect effects	Standardised coefficients (β)	
	Actual	Preferred
Computer usage → Teacher support	0.39***	0.38***
Teacher support → Young adult ethos	0.41***	0.34***
Computer usage → Young adult ethos	0.20***	0.27***
Young adult ethos → Equity	0.48***	0.59***
Teacher support → Equity	0.38***	0.22***
Young adult ethos → Student cohesiveness	0.32***	0.20***
Equity → Student cohesiveness	−0.05	0.10***
Teacher support → Student cohesiveness	0.32***	0.44***
Equity → Task orientation	0.24***	0.40***
Computer usage → Task orientation	0.09***	−0.01
Young adult ethos → Task orientation	0.29***	0.27***
Student cohesiveness → Task orientation	0.21***	0.24***
Computer usage → Involvement	0.13***	0.18***
Task orientation → Involvement	0.25***	0.24***
Student cohesiveness → Involvement	0.33***	0.29***
Teacher support → Differentiation	0.17***	0.09***
Teacher support → Involvement	0.28***	0.27***
Computer usage → Differentiation	0.57***	0.59***
Differentiation → Investigation	0.18***	0.06*
Computer usage → Investigation	0.24***	0.34***
Involvement → Investigation	0.31***	0.33***
Task orientation → Investigation	0.20***	0.16***
Investigation → Cooperation	0.11***	0.13***
Young adult ethos → Cooperation	0.13***	0.06
Student cohesiveness → Cooperation	0.33***	0.16***
Computer usage → Cooperation	0.16***	0.16***
Involvement → Cooperation	0.07*	0.24***
Equity → Cooperation	0.03	0.29***
Task orientation → Cooperation	0.12***	0.09

* $p < 0.05$; *** $p < 0.001$

students in computerised elementary and middle schools reported a higher level for the preferred state than for the actual state in general and for most of the characteristics (student cohesiveness, student involvement, investigation, equity, differentiation and young adult ethos). In other words, students preferred these characteristics to be at higher levels relative to the current state in the classroom in elementary and middle schools.

These findings complement a study conducted in Israel which revealed that, with increasing grade levels, there was a decline in the quality of the learning environment and students' satisfaction with the school, because teachers focus more on achievement scores and less on pedagogical processes (Magen-Nagar and Shachar 2016). The findings also reveal that gaps between actual and preferred states are similar for both elementary- and middle-school students, therefore indicating similar desires for a better learning

environment. The gaps between actual and preferred could stem from students' own technological devices which offer a range of personal options for learning (Aldridge et al. 2013). Hence students could be expecting the classroom learning environment to offer a richer range of tools and skills to help them cope better with changing reality. This kind of learning environment encourages friendship in the class, increases interest and involvement in the learning, promotes investigation of study topics, enables equitable treatment of students, offers meaningful learning for every student and develops responsible independent learners.

Later on, path analysis using SEM analysis that revealed a very complex and complete picture which one can assume is the closest to reality. The analysis model showed that the direct and indirect influences among the learning environment characteristics were many and mostly significant, when computer usage was the independent variable, cooperation was the dependent variable and all the rest were mediating variables. This structure showed the actual and expected strong connections between the characteristics of the innovative learning environment and their interdependence, with the computer or any other technology device driving the learning processes in class as far as cooperative learning. In an online environment, complex study behaviours require a learning environment in the context of constructing knowledge through a cooperative process, taking advantage of the inherent potential of technology (Bonk 2010; Jarvela et al. 2011). The current study clarified the place of technology in the lesson and emphasised that, when building a teaching unit based on investigation and cooperation, one must first examine the potential inherent in the contribution of technology to attainment of the learning objectives. Intelligent use of technology in a constructivist environment can augment the cooperation among the learners.

Cooperation involves mutual dependence, useful interaction and a group process. A meta-analysis revealed that, in situations of positive mutual dependence, students' achievement and motivation were higher than in situations of negative or no dependence (Johnson et al. 2014). It was also found that cooperative learning has a stronger effect on achievement in elementary and middle schools than studying from digital textbooks and/or dedicated technology (Slavin 2013). Hence, we can assume that a source of good learning, according to students' perceptions, is the use of the computer, because the constructivist learning processes of teacher support, differentiation between learners, independent learning, student cohesiveness, equity among students, study task orientation, active involvement and investigation of topics all lead to cooperative learning. It would seem that learning behaviours such as these can improve learners' achievements.

The findings of the SEM analysis illustrate the importance of the developmental features of childhood and adolescence during learning. The analysis shows that, in the actual state, student cohesiveness was a key factor in predicting the level of student cooperation whereas, in the preferred state, it was equity. In other words, in the actual state, the friendlier the students were with each other, the higher was their level of cooperation, performing learning tasks together, sharing ideas and creating joint learning products. These findings concur with the accumulated knowledge of the theoretical and research literature. The ability to learn cooperatively derives from the nature and intensity of the interpersonal relations in the class (Johnson et al. 2014). The student cohesiveness expressed in good interpersonal relations affects not only the general atmosphere in the class, but also concrete behavioural aspects involving the degree of students' involvement, support and reciprocal help that they give each other as they learn (Cohn and Fraser 2016). In the preferred state, the greater the equitable treatment from the teacher, the higher the level of cooperation. The challenge of cooperation is essential and particularly important in

the Israeli population. Given the strengthening of trends of individualisation and globalisation processes that erode social cohesiveness in Israeli society (Tobin and Lis 2013) and as a country that absorbs immigration, mainly from Ethiopia and the Former Soviet Union, most classes have a diverse, multicultural population. Indeed, because of the inevitable academic, social and cultural gaps between native Israeli and new immigrant students, the latter lack a sense of belonging to the setting (Shmuel 2015), which is essential for the development of a cooperative learning environment based on equity. The class constitutes a social study unit in which students try to integrate into the peer group by building positive relations with their teachers and other students and by receiving equal treatment from those around them (i.e. from teachers and classmates) (Burić 2015; Williford et al. 2013). Fulfilling these basic needs can contribute to effective twenty-first century learning that is rich in communication and cooperation. Hence learning environments should take into account developmental aspects in social contexts.

The importance of this study that it is one of the first learning environment studies in Israel to examine issues on a large scope from the perspective of the student, making first use of a valid and reliable universal measurement tool. The timing of the study is also significant. In 2010, Israel launched its national ICT program in an attempt to adapt the education system to the demands of the twenty-first century. However, the integration of technology was not a goal in itself, but rather was used as leverage for educational change and pedagogical innovation. This reform is still causing gradual changes in the perception of effective learning and its objectives, in teaching and learning methods and in the assessment of learning. These changes have a direct impact on the learning environment. Because the end client of the education system is the student, an examination of students' perceptions of the characteristics of their learning environment might be the real test of the success of the reform and its goals. As Cohn and Fraser (2016) claim, students spend many hours in the classroom where they encounter different learning situations and so justifiably they are the ones to evaluate their learning environment.

Based on our research findings, we recommend helping teachers to develop an innovative learning environment that emphasises cooperation so that students are ready to handle the challenges of the future. One limitation of this study relates to the TROFLEI which was developed in the twentieth century; we recommend updating the parameter of computer usage so that it corresponds to the digital literacy of the twenty-first century. Given the range of computerised schools in Israel that have different educational goals and different mindsets regarding technology, further research is recommended into differences in perceptions of the innovative learning environment between different types of schools (such as public and private, religious and secular, Jewish and Arab) and different class levels.

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