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Factors explaining the learning of generic skills: a study of university students' experiences

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ABSTRACT

Although generic skills have received widespread attention from both policymakers and educationalists, little is known regarding how students acquire these skills, or how they should best be taught. Hence, the aim of this study was to identify what kinds of pedagogical practices are behind the learning of eight particular generic skills. The data were collected from university students ($N = 163$, $n = 123$) via Internet questionnaires. The findings from regression analyses showed that teaching practices involving collaboration and interaction as well as features of a constructivist learning environment and integrative pedagogy predicted the learning of generic skills – such as decision-making skills, different forms of creativity, and problem-solving skills. In contrast, the traditional forms of university teaching – such as reading, lecturing, and working alone – were negatively associated to learning generic skills. Overall, this study offers detailed information about the pedagogical practices that nurture learning generic skills in university contexts.

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Introduction

Generic skills (also referred to as 'generic attributes', 'key skills', and 'core competencies', for example) are greatly used and respected in current discussions in society, education and working life. At the beginning of the millennium, the Organization for Economic Co-operation and Development (OECD) initiated the *Definition and Selection of Key Competencies* project, which defined the key competencies that are required by all citizens for a successful life and for a well-functioning society (Rychen and Salganik 2003). Generic skills have also been included in national and international qualification frameworks such as the European Qualifications Framework (EQF), which enables a comparison of learners' knowledge, skills and competencies irrespective of where they gained their qualifications (European Qualifications Framework 2008). Worldwide, numerous business leaders, politicians and educators have developed models and lists of twenty-first century skills that pupils and students need in their lives and work, both today and in the future (e.g. ACT21S 2012; Fadel, Bialik, and Trilling 2015; Gordon et al. 2009; P21).

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Generic skills have also been emphasised in national and international assessments and comparisons of education systems with a view to improving the quality of teaching and learning. For example, the OECD recently conducted a *Feasibility Study for the Assessment of Higher Education Learning Outcomes,* the purpose of which was to examine whether it is possible to compare the knowledge and skills of higher education students from different countries (Coates and Richardson 2011; Trembley, Lalancette, and Roseveare 2012). According to several predictions, the role of generic skills will be emphasised in the working world in the future (e.g. Forbes 2013; Future Work Skills 2020 2011; New Skills for New Jobs 2010), and recent studies from different fields have similarly shown that the skills that workers need as part of employers' occupational requirements are not only field-specific (i.e. vocational/professional skills) but also generic, such as social skills, organizing skills, skills for knowledge acquisition, and problem-solving skills (Arevalo et al. 2010; Tynjälä et al. 2006; Virtanen, Tynjälä, and Collin 2009).

Although generic skills have received widespread attention from both policymakers and educationalists, little is known regarding how students acquire these skills, or how they should best be taught. For example, in the university setting, generic skills have been taught as separate courses (e.g. courses on speech communication, scientific writing, or presentation skills), or have been integrated within subjects (e.g. an information retrieval course as a part of a research seminar). There is also research evidence indicating that generic skills develop when certain kinds of pedagogical approaches, such as active learning methods and group activities, are used (e.g. Ballantine and McCourt Larres 2007; Kember 2009; Smith and Bath 2006).

Pedagogical practices nurturing the learning of generic skills in higher education

Crebert et al. (2004) examined the learning of generic skills in different contexts: at university, in work placements, and in employment. They found that 80% of graduates learned generic skills in equal proportions in university and in working life. The graduates asserted that the best way to learn such skills in the university context was to join in with various group activities, while in the working life context it was to work with other employees. In other words, in both examined contexts, the graduates found that situations that demanded collaboration and interaction allowed them to most develop their generic skills.

Other studies have supported these findings indicating that the learning of generic skills requires practices that include mutual interaction and activities. For example, Moy (1999) and de la Harbe, Radloff, and Wyber (2000) showed that collaborative rather than individual learning promotes the acquisition of such skills. Similarly, Ballantine and McCourt Larres (2007) noticed that the cooperative learning approach was beneficial in developing students' generic skills. Smith and Bath (2006) found that that the social, interactive and collaborative characteristics of students' experiences of university life are important determinants of generic graduate outcomes. Furthermore, they stressed that whilst engagement in social, interactive and collaborative forms of learning was a significant determinant of generic graduate outcomes, the development of knowledge of specific disciplines also appeared to be more closely tied to the socially interactive aspects of learning environments than many people might assume (Smith and Bath 2006).

Kember and Leung (2005; also Kember 2009; Kember, Leung, and Ma 2007) connected the study of learning generic skills to the nature of wider teaching and the learning environment. They studied the connection between students' experiences of learning generic skills and the learning environment at a university in Hong Kong, using an extensive questionnaire. Their results showed that the characteristics of the learning environment that particularly developed students' generic skills were teaching for understanding, active learning, a variety of assessment methods that require the deployment of the desired capabilities, and working together. These features of teaching and learning are directly related to the characteristics of constructivist learning environment (CLE) (e.g. Duffy, Lowyck, and Jonassen 1993; Loyens and Gijbels 2008; Tynjälä 1999; Tynjälä et al. 2009; Tynjälä and Gijbels 2012; von Glasersfeld 1995). One application of CLE theory is the model of integrative pedagogy (IP), which connects the features of the constructivist teaching and learning with the accounts of the nature and the development of expertise (e.g. Bereiter 2002; Bereiter and Scardamalia 1993; Eraut 2004; Le Maistre and Paré 2006; Leinhardt, McCarthy Young, and Merriman 1995). According to these, expertise consists of four basic elements: 1) theoretical, conceptual knowledge; 2) practical, experiential knowledge; 3) self-regulative knowledge; and 4) sociocultural knowledge. As these elements are integrated and fused with each other in high-level expertise – rather than being separate – the IP model is based on the premise that to support the expertise development the all four elements of expertise or knowledge should be present in learning situations, and these elements should be integrated and connected with each other. For such integration, different pedagogical tools such as group discussions, learning diaries, project assignments, analytic writing tasks and collaborative work can be used. The purpose is that students apply theoretical knowledge to solve practical problems and, correspondingly, conceptualise their practical experiences using theoretical concepts (Tynjälä 2008; Tynjälä and Gijbels 2012). In other words, the model favors combining authentic or simulated practical experiences with theoretical contents and conceptual learning. In the IP model, the focal pedagogical processes are reflection and problem solving. The model has proved to be promising with regard to learning outcomes in different fields of higher education, vocational education and training, and workplace learning (e.g. Heikkinen, Tynjälä, and Kiviniemi 2011; Ortoleva and Bétrancourt 2015; Täks et al. 2014; Tynjälä, Häkkinen, and Hämäläinen 2014; Tynjälä et al. 2016; Virtanen, Tynjälä, and Eteläpelto 2014).

Purpose of the study

The literature reviewed above suggests that teaching practices and methods that demand active interaction and collaboration, and which utilize the features of the CLE and the IP model, foster the learning of generic skills. However, there remains a lack of detailed information, that is, information regarding the types of teaching practices and methods that foster the learning of specific generic skills, such as problem-solving skills, critical thinking, or creativity. Therefore, this study aimed to identify what kinds of pedagogical practices are behind the learning of particular generic skills. In more detail, the following overarching research question was addressed: Which pedagogical practices explain students' (self-assessed) learning of generic skills?

Data and research participants

Research materials were collected from students ($N = 163$) taking a university course in one of three different subjects: chemistry, physical education, and teacher education. In total, 123 students (75%) answered the questionnaire, in which they were asked to assess the pedagogical practices of the course they were studying and their development of different generic skills during the course. Of the responders, 38% were male and 62% female, and their average age was 22 years. The majority (53%) were second-year students, while 31% were first-year students, and 16% were students in other years (3–6).

Methods

A confirmatory regression analysis (stepwise model) was used. This method makes it possible to assess the emphasis and range of different aspects of the pedagogical practices under investigation (e.g. Cooligan 2004).

Dependent variables: generic skills

The eight dependent variables (i.e. generic skills) assessed were drawn from frameworks for the learning of twenty-first century skills (e.g. ATC21S 2012; P21; Gordon et al. 2009). In her framework, Binkley together with her colleagues (2012) defined ten twenty-first century skills, dividing them into four broad categories: 1) ways of thinking (creativity and innovation; critical thinking, problem solving, decision making; and learning to learn or to use metacognition); 2) ways of working (communication; and collaboration); 3) tools for working (information literacy; and ICT literacy); and 4) ways of living in the world (citizenship; life and career; and personal and social responsibility). The present study focused on skills concerning ways of thinking, since these i) are considered to be essential skills in working life today and in the future (e.g. Forbes 2013; Future Work Skills 2020 2011; New Skills for New Jobs 2010); ii) are characterized as higher-order thinking skills (HOTS) that university education has been traditionally expected to develop in its students (e.g. Bloom 1956; Wilks 1995; Zohar 2006; Zohar and Dori 2003); and iii) have been central in debates regarding generic skills in higher education over the last 30 years (e.g. Badcock, Pattison, and Harris 2010; Barrie 2006; Bennett et al.1999; Clanchy and Ballard 1995; Jones 2009, 2013; Krause 2014). Table 1 shows the type of variables or skills that this study used to examine the above-mentioned ways of thinking (Binkley et al. 2012).

The first category, creativity and innovation, comprises two generic skill groups: *resourcefulness, innovativeness, and creativity,* and the *ability to operate in new situations*. The first of these represents creativity in general, and the second represents creativity on a more concrete level, specifically, on the level of action (see Sawyer 2012). The second category is comprised of traditional higher-order thinking skill groups: *critical thinking skills,*

Table 1. Definition of generic skills examined.

Ways of thinking (according to the definition of Binkley et al. 2012)	Skills in this study
I. Creativity and innovation	(1) Resourcefulness, innovativeness, and creativity
	(2) Ability to operate in new situations
II. Critical thinking, problem solving, and decision making	(3) Critical thinking skills
	(4) Problem-solving skills
	(5) Decision-making skills
	(6) Ability to solve occupational problems
III. Learning to learn or to use metacognition	(7) Continuing learning skills
	(8) Self-assessment skills

problem-solving skills, and *decision-making skills* (e.g. Barak, Ben-Chaim, and Zoller 2007; Bloom 1956). The *ability to solve occupational problems* was added to this category because problem-solving skills as such refer to solving problems at the general or abstract level, while the ability to solve occupational problems maps problem solving on a more concrete and domain-specific level. The third category, *learning to learn or to use metacognition,* consists of two generic skill groups: *continuing learning skills* and *self-assessment skills*. These skills can be viewed as components of lifelong learning (e.g. Boud 2000; Crisp 2012) and professional identity (e.g. Eteläpelto et al. 2014). In practizing their self-assessment skills, students become aware of the strengths and weaknesses of their competencies; this has been considered to be essential for individuals' awareness of their own professional identity (Virtanen, Tynjälä, and Stenström 2008). The skills of the third category are also essential for the development of expertise (e.g. Bereiter 2002; Eraut 2004; Le Maistre and Paré 2006), since theoretical knowledge, practical knowledge and self-regulatory knowledge (i.e. metacognitive skills) are interwoven in the actions of experts (e.g. Bereiter 2002; Ericsson et al. 2006). Therefore, it has been suggested that students should be educated using pedagogy that enables all these forms of knowledge to be present and integrated in teaching or learning situations (e.g. Tynjälä 2008). In the questionnaire, the participating university students were asked to use a five-point scale to assess the extent to which they had learned the earlier mentioned eight different generic skills during their university course.

Independent variables: pedagogical practices

Students' perceptions of the pedagogical practices in their course were examined in regard to the following four categories: 1) forms of teaching and learning; 2) constructivist learning environment (CLE) and integrative pedagogy (IP); 3) clarity of assessment criteria; and 4) course learning atmosphere.

First, the students were asked to assess 12 different forms of teaching and learning (e.g. listening, reading, and lecturing) during their courses, using a five-point scale. These were based on studies that described pedagogical practices in different disciplines (e.g. Lueddeke 2003; Neumann, Parry, and Becher 2002; Smeby 1996; Ylijoki 2000).

Second, the students were asked to assess 24 different pedagogical elements of the courses (e.g. utilizing students' earlier experiences, comparing different theories, and collaborative learning) using a five-point scale. These questions were based on features of CLE (e.g. Duffy, Lowyck, and Jonassen 1993; Loyens and Gijbels 2008; Tynjälä 1999; Tynjälä et al. 2009; Tynjälä and Gijbels 2012; von Glasersfeld 1995) and the model of IP (e.g. Tynjälä 2008; Tynjälä et al. 2016). The CLE and IP features were divided into four aggregate scales according to the above-described theoretical bases (Table 2). The CLE involved the following aggregate scales: 1) *Sharing and utilizing students' earlier experiences and knowledge* ($\alpha = .89$; four items); 2) *Feedback, assessment, and summarizing tasks* ($\alpha = .87$; five items); and 3) *Critical examination of knowledge* ($\alpha = .86$; six items). The features of the IP model are present in the aggregate scale *Acting at the interface between theory and practice* ($\alpha = .89$; eight items) and one single variable, *Learning of theoretical knowledge*. Cronbach's alpha was used as a reliability coefficient. As generally recommended, only variables that showed a correlation of at least .30 with the aggregate scale were accepted (see. e.g. Costello and Osborne 2005; Tabachnick and Fidell 2001).

In all aggregate scales, the reliability coefficient Cronbach's alpha was over .80, and the smallest correlation of the item with the aggregate scale was .550 (Table 2). In other words, the internal consistency of the aggregate scales was very high.

Third, students were asked to assess the clarity of the assessment criteria (according to the statement: 'The assessment criteria of the study module were clear to me during the entire course'). It has been found that such an assessment directs studying and learning more than any other variable in a learning situation (e.g. Biggs and Tang 2007). In other words, students tend to study according to how their learning will be assessed (Struyven, Dochy, and Janssens 2005). In addition, type of assessment which supports learning is an essential feature of the CLE (Tynjälä 1999).

Fourth, students were asked to assess six different statements related to the atmosphere of the course: 'It was easy to discuss with the teacher'; 'It was easy to share my own opinions and thoughts'; 'There was a low threshold to ask about things that remained unclear'; 'Collaboration with other students was easy'; 'It was easy to get my own voice heard'; 'There was a strong sense of "we-ness" among the students in the course'. It has

Table 2. Alphas, items, and correlations of aggregate scales describing the pedagogical practices of the courses (CLE = Constructivist Learning Environment, IP = Integrative Pedagogy).

Aggregate scale	Cronbach's alpha	Items	Correlations of the item with the aggregate scale
Sharing and utilizing students' earlier experiences and knowledge (CLE)	.89	• Sharing personal experiences	.838
		• Learning from other students' experiences	.820
		• Utilizing other students' experiences	.810
		• Utilizing other students' earlier knowledge	.550
Acting at the interface between theory and practice (IP)	.89	• Acquiring practical knowledge	.771
		• Integrating theory and practice	.768
		• Teacher relating and demonstrating practical examples	.676
		• Connections between teaching and working life	.661
		• Students looking for examples on their own	.638
		• Applying theory to practice	.622
		• Analysing familiar phenomena with the help of theoretical knowledge	.605
		• Analysing students' own learning experiences with the help of theoretical knowledge	.578
Feedback, assessment,and summarizing tasks (CLE)	.87	• Receiving feedback	.808
		• Practising giving feedback	.767
		• Summarizing of key contents by the students	.704
		• Summarizing of key contents by the teacher	.638
		• Developing assessment skills	.562
Critical examination of knowledge (CLE)	.86	• Analyzing things from different perspectives	.708
		• Critical evaluation of theories by the teacher	.676
		• Critical evaluation of theories by the students	.666
		• Developing a critical view	.656
		• Seeking different explanations for the same thing	.610
		• Comparing different theories	.581

Table 3. A summary of the dependent and independent variables of this study.

Dependent variables (8)	Independent variables (19)
(1) Resourcefulness, innovativeness, and creativity	Forms of teaching and learning:
(2) Ability to operate in new situations	(1) Lecturing
(3) Critical thinking skills	(2) Direction or guidance from teacher
(4) Problem-solving skills	(3) Feedback or evaluation given by teacher
(5) Decision-making skills	(4) Discussion
(6) Ability to solve occupational problems	(5) Listening
(7) Continuing learning skills	(6) Observing
(8) Self-assessment skills	(7) Reading
	(8) Writing
	(9) Assessing one's own work
	(10) Assessing other students' work
	(11) Working alone
	(12) Working with others
	Features of a constructivist learning environment:
	(13) Students sharing and utilizing their earlier experiences and knowledge
	(14) Feedback, assessment, and summarizing tasks
	(15) Critical examination of knowledge
	Features of integrative pedagogy:
	(16) Acting at the interface between theory and practice
	(17) Learning of theoretical knowledge
	Atmosphere on the course:
	(18) Positive atmosphere during the course
	Assessment:
	(19) Clear assessment criteria

been shown that the learning atmosphere plays a remarkable role (Kiuru et al. 2015), particularly with regard to creativity (e.g. Binkley et al. 2012; Eteläpelto and Lahti 2008; Hämäläinen and Vähäsantanen 2011). These statements formed the aggregate scale of *Positive atmosphere during the course* ($\alpha = .83$; six items). Both pedagogical practices and particular generic skills are summarized in Table 3.

Results

Due to space limitations, collinearity statistics (tolerance and variation inflation factor; VIF) are not presented in the tables. Both of the indices that measured the degree of multicollinearity (i.e. correlation) were within the limits of those indices (e.g. Azen and Budescu 2009; Cooligan 2004): the values of tolerance varied between .465–1.000, and the VIF values were between 1.000 and 2.160.

Predictors of learning creativity

The regression model explained 36% of the variance of the learning of resourcefulness, innovativeness and creativity, and 42% of the learning of the ability to operate in new situations (Table 4). As Table 4 shows, different variables explained the learning of the different aspects of creativity. The critical examination of knowledge ($\beta = .425$), a feature of the CLE, was the strongest predictor of the creativity at the general level (i.e. resourcefulness, innovativeness and creativity). The second strongest predictor was how positive the atmosphere of the learning situation was ($\beta = .248$). The learning of creativity at the level of action (i.e. the ability to operate in new situations) appeared to demand

Table 4. Regression model for resourcefulness, innovativeness and creativity (36%), and the ability to operate in new situations (42%).

RESOURCEFULNESS, INNOVATIVENESS, AND CREATIVITY	*R*	R^2	*Adjusted* R^2	*Std. error of estimate*	
	.604	.364	.346	.747	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.026	4.353	1, 107	.039	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Critical examination of knowledge	.461	.088	.428	5.260	.000
2) Positive learning atmosphere during the course	.542	.176	.248	3.073	.003
3) Lecturing	−.193	.092	−.163	−2.086	.039
ABILITY TO OPERATE IN NEW SITUATIONS	*R*	R^2	*Adjusted* R^2	*Std. error of estimate*	
	.644	.415	.399	.774	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.023	4.221	1, 107	.042	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Acting at the interface between theory and practice	.522	.134	.395	3.880	.000
2) Reading	−.317	.098	−.246	−3.247	.002
3) Sharing and utilizing students' earlier experiences and knowledge	.261	.127	.213	2.055	.042

concrete action: *acting* at the interface between theory and practice ($\beta = .395$), a central feature of IP, and *sharing* and *utilizing* students' earlier experiences and knowledge ($\beta = .213$), a feature of the CLE, were the strongest and the third strongest predictors, respectively. Interestingly, regarding both aspects of creativity, the traditional or individual forms of learning, lecturing and reading loaded negatively in the model used. In other words, students felt that the more lecturing and individual forms of learning such as reading were used, the less they learnt creativity.

Predictors of learning higher-order thinking skills

Higher-order thinking skills consisted of four different skills. The results relating to the learning of critical thinking and decision-making skills are presented in Table 5, and the results concerning problem-solving skills and the ability to solve occupational problems are shown in Table 6.

The regression model did not clearly explain the learning of critical thinking: only one variable, the critical examination of knowledge ($\beta = .426$), loaded in the model and it explained 18% of the learning of critical thinking among university students (Table 5). This variable is a feature of the CLE. The model concerning the learning of decision-making skills explained more, that is, 32% of the variance. Here, working with other students ($\beta = .226$), assessment of other students' work ($\beta = .223$), and feedback, assessment and summarizing tasks ($\beta = .222$) were the strongest predictors (Table 5).

The regression model concerning the learning of problem-solving skills was strong (Table 6). It explained 49% of the variance of problem-solving skills, and 47% of the

Table 5. Regression models for critical thinking (18%) and decision-making skills (32%).

CRITICAL THINKING	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.426	.182	.174	.827	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.182	24.189	1, 109	.000	
Predictors	Unstandardized coefficients		Standardized coefficients		
	B	*Std. error*	*β*	*t*	*Sig.*
1) Critical examination of knowledge	.452	.092	.426	4.918	.000
DECISION-MAKING SKILLS	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.567	.321	.302	.785	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.030	4.627	1, 106	.034	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Working with others	.204	.093	.226	2.202	.030
2) Assessment of other students' work	.226	.105	.223	2.151	.034
3) Feedback, assessment, and summarizing tasks	.257	.133	.222	1.936	.056

Table 6. Regression models for problem-solving skills (49%) and the ability to solve occupational problems (47%).

PROBLEM-SOLVING SKILLS	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.697	.486	.467	.783	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.028	5.834	1, 106	.017	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Acting at the interface between theory and practice	.446	.131	.314	3.394	.001
2) Reading	−.312	.113	−.225	2.754	.007
3) Working with others	.220	.106	.212	2.077	.040
4) Assessment of other students' work	.236	.098	.203	2.415	.017
ABILITY TO SOLVE OCCUPATIONAL PROBLEMS	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.687	.472	.462	.698	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.046	9.357	1, 108	.003	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Acting at the interface between theory and practice	.757	.091	.601	8.346	.000
2) Working alone	−.205	.067	−.220	−3.059	.003

ability to solve occupational problems. The main element of IP, that is, acting at the interface between theory and practice, was the most important predictor for both skills ($\beta = .314$ for the problem-solving skills; $\beta = .601$ for the ability to solve occupational problems). Working with others and the assessing of other students' work were also important predictors of the learning of problem-solving skills. Interestingly, the forms of individual learning, that is, reading and working alone, again loaded negatively in the models. In sum, the more the students felt that their learning environment included interaction between theory and practice and also working with others, the more they reported learning problem-solving skills. In contrast, the more their course involved reading and working alone, the less they felt that they had learned problem-solving skills.

Predictors of the development of lifelong learning skills

Lifelong learning skills were examined from two different perspectives: as continuing learning skills and as self-assessment skills (Table 7). The regression model rather weakly explained the development of continuing learning skills (24%), but moderately (39%) the learning of self-assessment skills. Not surprisingly, assessing one's own work as part of studying was the strongest predictor of learning self-assessment skills ($\beta = .420$) and the second strongest predictor of continuing learning skills ($\beta = .185$). The features of the CLE explained both skills: critical examination of knowledge was the strongest predictor in the development of continuing learning skills ($\beta = .396$), whereas the combination of feedback, assessment and summarizing tasks was the second strongest predictor of the learning of self-assessment skills ($\beta = .286$).

Discussion

This study examined what kinds of pedagogical practices are behind the learning of particular generic skills. It was found that the learning of such skills did not depend on any single method of teaching or particular pedagogical practice. Rather, learning generic skills demanded the use of various teaching methods and the utilization of different pedagogical practices.

The findings are in accordance with those of earlier studies (e.g. Crebert et al. 2004; Kember 2009; Kember and Leung 2005; Smith and Bath 2006): teaching practices involving collaboration and interaction fostered the learning of generic skills, particularly the learning of decision-making and problem-solving skills. The pedagogical practices that predicted students' learning of generic skills most strongly were those that belonged to the CLE features (i.e. critical examination of knowledge; sharing and utilizing students' earlier experiences and knowledge; and feedback, assessment and summarizing tasks) along with the IP features (i.e. acting at the interface between theory and practice). Recent findings have shown that a positive learning atmosphere plays an important role

Table 7. Regression model for continuing learning skills (24%) and self-assessment skills (39%).

CONTINUING LEARNING SKILLS	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.486	.236	.222	.901	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.031	4.348	1, 108	.039	
Predictors	Unstandardized coefficients		Standardized coefficients		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Critical examination of knowledge	.471	.105	.396	4.475	.000
2) Assessing one's own work	.211	.101	.185	2.085	.039
SELF-ASSESSMENT SKILLS	*R*	*R*^{2}	*Adjusted R*^{2}	*Std. error of estimate*	
	.628	.394	.383	.858	
	R^2 *change*	*F change*	*df1, df2*	*Sig. F change*	
	.056	9.831	1, 107	.002	
Predictors	Unstandardized coefficients		Standardized coefficient		*Sig.*
	B	*Std. error*	*β*	*t*	
1) Assessing one's own work	.511	.111	.420	4.612	.000
2) Feedback, assessment, and summarizing tasks	.384	.122	.286	3.135	.002

in learning (e.g. Hämäläinen and Vähäsantanen 2011; Kiuru et al. 2015), and this was also observed in the present study: the positive learning atmosphere was an important predictor of learning creativity. This finding is logical: an emotionally safe environment (see Eteläpelto and Lahti 2008) certainly encourages students to express new, perhaps non-traditional ideas and to try new ways of doing things.

In addition, regarding university studies, the present research shows that it is important to use versatile forms of assessment, such as self-assessment, peer-assessment and the giving and receiving of feedback. For example, assessing one's own work as part of studying was the most important predictor of learning self-assessment skills, which, correspondingly, is an important factor in an individual's own continuous professional development (e.g. Eteläpelto et al. 2014; Kearney 2013). Thus, the findings regarding assessment in the present study were in line with those of recent studies, which have emphasized the importance of students taking an active role in the assessment process (e.g. Boud 2000; Kearney 2013; Sandler and Good 2006).

One of the crucial findings of the present study was that the traditional forms of university teaching and studying, such as reading, lecturing and working alone, actually correlated negatively with the learning of generic skills. More precisely, lecturing was negatively associated with the learning of creativity, reading was negatively related to the ability to operate in new situations as well as to problem-solving skills, and working alone was negatively correlated with the ability to solve occupational problems. In other words, the more students' learning environments included traditional forms of teaching, the less students reported learning particular generic skills. These remarkable findings should be considered seriously in the planning of university teaching. It is obvious that while traditional teaching and studying may be important for learning theoretical knowledge, they are not enough for learning generic skills needed in working life. Therefore, we suggest that when traditional forms of studying are used, they should be combined with methods that encourage students to actively process study contents, connect theory with practice, and collaborate with others.

The pedagogical practices examined particularly well predicted (42–49%) the learning of three skills: problem solving, the ability to solve occupational problems, and the ability to operate in new situations. All of these skills were strongly explained by the essence of integrative pedagogy, that is, acting at the interface of theory and practice. Thus, this study confirmed earlier findings regarding the feasibility of integrative pedagogy in the learning and professional development of students and workers in different contexts (e.g. Heikkinen, Tynjälä, and Kiviniemi 2011; Täks et al. 2014; Tynjälä et al. 2016; Virtanen, Tynjälä, and Eteläpelto 2014).

In regard to predicting the learning of critical thinking skills, the present study was weak; the regression model explained only 18% of the learning of these skills. To understand this finding, critical analysis is required with regard to the instruments used in this study. It is possible that it is difficult for students to evaluate their critical thinking skills, given that the majority of participants were the second (53%) and first year (31%) students. Furthermore, the development of critical thinking is a long process (e.g. Halford 2005; Kallio 2011), which may be hard to recognize during a single course. Hence, more studies on the learning of critical thinking, as well as other generic skills, will be needed. In the future, the role of student characteristics such as age, study year and discipline should be taken into account more accurately. It has been found, for example, that the age of individuals has a remarkable role in the development of critical thinking (e.g. Hyytinen 2015). Also, the research instrument should be developed to identify those mechanisms and practices which support the development of critical thinking.

To conclude, the present study highlights the role of pedagogical practices in the learning of generic skills. In other words, when certain kinds of teaching methods and pedagogical practices are used, generic skills can be learned as by-products of subject studies. At the same time, the findings of this study can be approached from the opposite direction: when intentionally teaching particular skills, it seems most promising to utilize the forms of teaching and pedagogical practices that are known to enhance these skills such as based on the present study.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

ACT21S. 2012. “Assessment & Teaching of 21st Century Skills.” Accessed September 12, 2016. http://www.atc21s.org/.

Arevalo, J., S. Pitkänen, D. Gritten, and L. Tahvanainen. 2010. “Market-relevant Competencies for Professional Foresters in European Graduate Education.” *International Forest Review* 12 (3): 200–208.

Azen, R., and D. Budescu. 2009. “Applications of Multiple Regression in Psychological Research.” In *The SAGE Handbook of Quantitative Methods in Psychology*, edited by R. E. Millsap, and A. Maydeu-Olivares, 285–310. London: SAGE.

Badcock, P. B. T., P. E. Pattison, and K.-L. Harris. 2010. “Developing Generic Skills Through University Study: A Study of Arts, Science and Engineering in Australia.” *Higher Education* 60 (4): 441–458.

Ballantine, J., and P. McCourt Larres. 2007. “Cooperative Learning: A Pedagogy to Improve Students’ Generic Skills?” *Education + Training* 49 (2): 126–137.

Barak, M., D. Ben-Chaim, and U. Zoller. 2007. “Purposely Teaching for the Promotion of Higher-order Thinking Skills: A Case of Critical Thinking.” *Research in Science Education* 37 (4): 353–369.

Barrie, S. 2006. “Understanding What We Mean by the Generic Attributes of Graduates.” *Higher Education* 51 (2): 215–241.

Bennett, N., E. Dunne, and C. Carre. 1999. “Patterns of Core and Generic Skills Provision in Higher Education.” *Higher Education* 37 (1): 71–93.

Bereiter, C. 2002. *Education and Mind in the Knowledge Age*. Mahwah, NJ: Erlbaum.

Bereiter, C., and M. Scardamalia. 1993. *Surpassing Ourselves: An Inquiry into the Nature of Expertise*. Chicago: Open Court.

Biggs, J. B., and C. Tang. 2007. *Teaching for Quality Learning at University: What the Student Does*. Buckingham: The Society for Research into Higher Education and Open University Press.

Binkley, M., O. Erstad, J. Herman, S. Raizen, M. Ripley, M. Miller-Ricci, and M. Rumble. 2012. “Defining Twenty-first Century Skills.” In *Assessment and Teaching of 21st Century Skills*, edited by P. Griffin, B. McGraw, and E. Care, 17–66. New York: Springer.

Bloom, B. S., ed. 1956. *Taxonomy of Educational Objectives: Handbook 1. Cognitive Domain*. New York: David McKay Company.

Boud, D. 2000. “Sustainable Assessment. Rethinking Assessment for the Learning Society.” *Studies in Continuing Education* 22 (2): 151–167.

Clanchy, J., and B. Ballard. 1995. “Generic Skills in the Context of Higher Education.” *Higher Education Research & Development* 14 (2): 155–166.

Coates, H., and S. Richardson. 2011. “An International Assessment of Bachelor Degree Graduates’ Learning Outcomes.” *Higher Education Management and Policy* 23 (3): 52–69.

Cooligan, H. 2004. *Research Methods and Statistics in Psychology*. 4th ed. London: Hodder Arnold.

Costello, A. B., and J. W. Osborne. 2005. “Best Practices in Explorative Factor Analysis. For Recommendations for Getting the Most from Your Analysis.” *Practical Assessment, Research & Evaluation* 10 (7): 1–9.

Crebert, G., M. Bates, B. Bell, C.-J. Patrick, and V. Cragnolini. 2004. “Developing Generic Skills at University, During Work Placement and in Employment: Graduates’ Perceptions.” *Higher Education Research & Development* 23 (2): 147–165.

Crisp, G. T. 2012. “Integrative Assessment: Reframing Assessment Practice for Current and Future Learning.” *Assessment & Evaluation* 37 (1): 33–43.

de la Harbe, B., A. Radloff, and J. Wyber. 2000. “Quality and Generic (Professional) Skills.” *Quality in Higher Education* 6 (3): 231–243.

Duffy, T. M., J. Lowyck, and D. H. Jonassen, eds. 1993. *Designing Environments for Constructive Learning*. NATO ASI Series. Series F: Computer and Systems Sciences, (105). Berlin: Springer.

EQF. 2008. “European Qualifications Framework.” Accessed June 9, 2016. http://ec.europa.eu/education/lifelong-learning-policy/eqf_en.htm.

Eraut, M. 2004. “Transfer of Knowledge between Education and Workplace Settings.” In *Workplace Learning in Context*, edited by H. Rainbird, A. Fuller, and A. Munro, 201–221. London: Routledge.

Ericsson, K. A., N. Charness, P. J. Feltovich, and R. R. Hoffmann, eds. 2006. *The Cambridge Handbook of Expertise and Expert Performance*. New York: Cambridge University Press.

Eteläpelto, A., and J. Lahti. 2008. “The Resources and Obstacles of Creative Collaboration in a Long-term Learning Community.” *Thinking Skills and Creativity* 3 (3): 226–240.

Eteläpelto, A., K. Vähäsantanen, P. Hökkä, and S. Paloniemi. 2014. “Identity and Agency in Professional Learning.” In *International Handbook of Research in Professional and Practice-based Learning*, edited by S. Billett, C. Harteis, and H. Gruber, 645–672. Dordrecht: Springer.

Fadel, C., M. Bialik, and B. Trilling. 2015. *Four-dimensional Education: The Competencies Learners Need to Succeed*. Boston: Center for Curriculum Redesign.

Forbes. 2013. “The 10 Skills That Will Get You Hired in 2013.” Assessed September 12, 2016. http://www.forbes.com/sites/meghancasserly/2012/12/10/the-10-skills-that-will-get-you-a-job-in-2013/#57b60d9664b0.

Future work skills 2020. 2011. Assessed September 12, 2016. http://www.iftf.org/uploads/media/SR-1382A_UPRI_future_work_skills_sm.pdf.

Gordon, J., G. Halasz, M. Krawczyk, T. Leney, A. Michel, D. Pepper, E. Putkiewicz, and J. Wisniewski. 2009. *Key Competences in Europe: Opening Doors for Lifelong Learners Across the School Curriculum and Teacher Education*. CASE Network Reports No. 87. Warsaw, Poland: CASE, Center for Social and Economic Research.

Halford, G. S. 2005. “Development of Thinking.” In *The Cambridge Handbook of Thinking and Reasoning*, edited by K. J. Holyoak, and R. G. Morrison, 529–558. Cambridge, UK: Cambridge University Press.

Hämäläinen, R., and K. Vähäsantanen. 2011. “Theoretical and Pedagogical Perspectives on Orchestrating Creativity and Collaborative Learning.” *Educational Research Review* 6 (3): 169–184.

Heikkinen, H. L. T., P. Tynjälä, and U. Kiviniemi. 2011. “Integrative Pedagogy in Practicum: Meeting the Second Order Paradox of Teacher Education.” In *A Practicum Turn in Teacher Education*, edited by M. Mattson, T. V. Eilertsen, and D. Rorrison, 91–112. Rotterdam: Sense Publishers.

Hyytinen, H. 2015. “Looking Beyond the Obvious: Theoretical, Empirical and Methodological Insights into Critical Thinking.” Doctoral thesis, University of Helsinki, Studies in Educational Sciences 260.

Jones, A. 2009. “Generic Skills as Espoused Theory: The Importance of Context.” *Higher Education* 58 (2): 175–191.

Jones, A. 2013. “There is Nothing Generic about Graduate Attributes: Unpacking the Scope of Context.” *Journal of Further and Higher Education* 37 (5): 591–605.
Kallio, E. 2011. “Integrative Thinking is the Key: An Evaluation of Current Research into the Development of Thinking in Adults.” *Theory & Psychology* 21 (6): 785–801.
Kearney, S. 2013. “Improving Engagement: The Use of ‘Authentic Self- and Peer-assessment for Learning’ to Enhance the Student Learning Experience.” *Assessment & Evaluation in Higher Education* 38 (7): 875–891.
Kember, D. 2009. “Nurturing Generic Capabilities Through a Teaching and Learning Environments Which Provides Practise in Their Use.” *Higher Education* 57 (1): 37–55.
Kember, D., and D. Y. P. Leung. 2005. “The Influence of Active Learning Experiences on the Development of Graduate Capabilities.” *Studies in Higher Education* 30 (2): 155–170.
Kember, D., D. Y. P. Leung, and R. S. F. Ma. 2007. “Characterizing Learning Environments Capable of Nurturing Generic Capabilities in Higher Education.” *Research in Higher Education* 48 (5): 609–632.
Kiuru, N., K. Aunola, M.-K. Lerkkanen, E. Pakarinen, E. Poskiparta, T. Ahonen, A. M. Poikkeus, and J.-E. Nurmi. 2015. “Positive Teacher and Peer Relations Combine to Predict Primary School Students’ Academic Skill Development.” *Developmental Psychology* 51 (4): 434–446.
Krause, K.-L. D. 2014. “Challenging Perspective on Learning and Teaching in the Disciplines: The Academic Voice.” *Studies in Higher Education* 39 (1): 2–19.
Leinhardt, G., K. McCarthy Young, and J. Merriman. 1995. “Integrating Professional Knowledge: The Theory of Practice and the Practice of Theory.” *Learning and Instruction* 5: 401–408.
Le Maistre, C., and A. Paré. 2006. “A Typology of the Knowledge Demonstrated by Beginning Professionals.” In *Higher Education and Working Life. Collaborations, Confrontations and Challenges*, edited by P. Tynjälä, J. Välimaa, and G. Boulton-Lewis, 103–113. Amsterdam: Elsevier.
Loyens, S. M. M., and D. Gijbels. 2008. “Constructivist Learning Environments: Introducing Multi-directional Approach.” *Instructional Science* 36 (5–6): 351–357.
Lueddeke, G. R. 2003. “Professionalising Teaching Practice in Higher Education: A Study of Disciplinary Variation and ‘Teaching-scholarship’.” *Studies in Higher Education* 28 (2): 213–228.
Moy, J. 1999. “The Impact of Generic Competencies on Workplace Performance.” Review of Research, National Centre for Vocational Education Research (NCVER).
Neumann, R., S. Parry, and T. Becher. 2002. “Teaching and Learning in Their Disciplinary Contexts: A Conceptual Analysis.” *Studies in Higher Education* 27 (4): 405–417.
New skills for new job. 2010. “European Commission.” Assessed September 12, 2016. http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/125en.pdf.
Ortoleva, G., and M. Bétrancourt. 2015. “Collaborative Writing and Discussion in Vocational Education: Effects on Learning and Self-Efficacy Beliefs. *Journal of Writing Research* 7 (1): 95–122.
P21. “Partnership for 21st Century Learning.” Assessed June 6, 2016. http:/www.p21.org/.
Rychen, D. S., and L. H. Salganik, eds. 2003. *Key Competencies for Successful Life and Well-functioning Society*. Cambridge, MA: Hogrefe & Huber.
Sandler, P., and E. Good. 2006. “The Impact of Self- and Peer-grading on Student Learning.” *Educational Assessment* 11 (1): 1–31.
Sawyer, R. K. 2012. *Explaining Creativity. The Science of Human Innovation*. 2nd ed. New York: Oxford University Press.
Smeby, J.-C. 1996. “Disciplinary Differences in University Teaching.” *Studies in Higher Education* 21 (1): 69–79.
Smith, C., and D. Bath. 2006. “The Role of the Learning Community in the Development of Discipline Knowledge and Generic Graduate Outcomes.” *Higher Education* 51 (2): 259–286.
Struyven, K., F. Dochy, and S. Janssens. 2005. “Students’ Perceptions about Evaluation and Assessment in Higher Education: A Review.” *Assessment & Evaluation in Higher Education* 30: 325–341.
Tabachnick, B. G., and L. S. Fidell. 2001. *Using Multivariate Statistics*. Boston: Allyn and Bacon.

Täks, M., P. Tynjälä, M. Toding, H. Kukemelk, and U. Venesaar. 2014. "Engineering Students' Experiences in Studying Entrepreneurship." *Journal of Engineering Education* 103 (4): 573–598.

Trembley, K., D. Lalancette, and D. Roseveare. 2012. "Assessment of Higher Education Learning Outcomes - AHELO. Feasibility study report. Volume 1 - Design and Implementation." OECD. http://www.oecd.org/edu/skills-beyond-school/AHELOFSReportVolume1.pdf.

Tynjälä, P. 1999. "Towards Expert Knowledge? A Comparison between a Constructivist and a Traditional Learning Environment in the University." *International Journal of Educational Research* 31 (5): 357–442.

Tynjälä, P. 2008. "Perspectives Into Learning at the Workplace." *Educational Research Review* 3 (2): 130–154.

Tynjälä, P., and D. Gijbels. 2012. "Changing World - Changing Pedagogy." In *Transitions and Transformations in Learning and Education*, edited by P. Tynjälä, M.-L. Stenström, and M. Saarnivaara, 3–49. Dordrecht: Springer.

Tynjälä, P., P. Häkkinen, and R. Hämäläinen. 2014. "TEL@works: Toward Integration of Theory and Practice." *British Journal of Educational Technology* 45 (6): 990–1000.

Tynjälä, P., M. Pirhonen, T. Vartiainen, and L. Helle. 2009. "Educating IT Project Managers Through Project-based Learning: A Working-life Perspective." *The Communications of the Association for Information Systems* 24: 270–288.

Tynjälä, P., V. Slotte, J. Nieminen, K. Lonka, and E. Olkinuora. 2006. "From University to Working Life: Graduates' Workplace Skills in Practice." In *Higher Education and Working Life: Collaborations, Confrontations and Challenges*, edited by P. Tynjälä, J. Välimaa, and G. Boulton-Lewis, 73–88. Amsterdam: Elsevier.

Tynjälä, P., A. Virtanen, U. Klemola, E. Kostiainen, and H. Rasku-Puttonen. 2016. "Applying Social Competence and other Generic Skills in Teacher Education: Applying the Model of Integrative Pedagogy." *European Journal of Teacher Education* 39 (3): 368–387.

Virtanen, A., P. Tynjälä, and K. Collin. 2009. "Characteristics of Workplace Learning Among Finnish Vocational Students." *Vocations and Learning* 2 (3): 153–175.

Virtanen, A., P. Tynjälä, and A. Eteläpelto. 2014. "Factors Promoting Vocational Students' Learning at Work: Study on Student Experiences." *Journal of Education and Work* 27 (1): 43–70.

Virtanen, A., P. Tynjälä, and M.-L. Stenström. 2008. "Field-specific Educational Practices as a Source for Students' Vocational Identity Formation." In *Emerging Perspectives of Workplace Learning*, edited by S. Billett, C. Harteis, and A. Eteläpelto, 19–34. Rotterdam: Sense Publishers.

von Glasersfeld, E. 1995. "A Constructivist Approach to Teaching." In *Constructivism in Education*, edited by P. Steffe, and J. Gale, 3–15. Hillsdale, NJ: Erlbaum.

Wilks, S. 1995. *Critical and Creative Thinking: Strategies for Classroom Inquiry*. Armadale, NSW: Eleanor Curtain.

Ylijoki, O.-H. 2000. "Disciplinary Cultures and the Moral Order of Studying – A Case-study pf Four Finnish University Departments." *Higher Education* 39 (3): 339–362.

Zohar, A. 2006. "The Nature and Development of Teachers' Metastrategic Knowledge in the Context of Teaching Higher Order Thinking." *Journal of the Learning Sciences* 15 (3): 331–377.

Zohar, A., and Y. J. Dori. 2003. "Higher Order Thinking Skills and Low-achieving Students: Are they Mutually Exclusive?" *Journal of the Learning Sciences* 12 (2): 145–181.