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Development of a self-assessment questionnaire for basic technical drawing skills: a preliminary study

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Abstract

The aim of this study was to develop and validate a new self-assessment questionnaire (SAQ) for basic technical drawing skills based on the Technical Drawing Evaluation Grid (TDEG) (Metraglia, Baronio & Villa, 2011). One hundred and seventeen first-year engineering students completed the TDEG-SAQ (first version) at the end of a training course of technical drawing. Eight factors relating to different skills were identified. Reliability analysis ranged from 0.74 to 0.92 for the questionnaire factors and was 0.96 for the overall questionnaire. Concurrent validity analysis showed the ability of the questionnaire to distinguish between genders and high school diplomas.

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Keywords: technical drawing, engineering graphics, self-assessment, questionnaire, education

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1. INTRODUCTION

Engineering graphics instruction is considered a process which has been significantly changing for the last years. The way engineering graphics is taught is changing as well (Clark & Scales, 2000), and engineering curricula have been improved to better prepare students for professional careers (Meyers, 2000). The ability to use 3-D software tools is currently considered the most important theme for industries, and software and technologies are becoming the core of engineering graphics courses. Traditional topics as manual geometry construction techniques and descriptive geometry are currently poorly considered both by students and faculties (Barr, 2012).
Despite the efforts in evolving the ways of teaching, problems related with poor skills in engineering drawing seem to apply globally: America (Nicolai, 1998 as cited in Abdullah, Field & Burvill, 2011); Asia, (Abdullah, Burvill & Field, 2011); Australia, (Field, Burvill and Weir, 2005 as cited in Abdullah, Field & Burvill, 2011); Europe (Beckmann & Krause, 2011). Particularly, skills on reading and interpretation of 2D drawings and understanding of the engineering technology contained in the drawn artifact (Abdullah, Field & Burvill, 2011) appear the most common matter to concern. That applies particularly for students without prior experiences in engineering drawing (Beckmann & Krause, 2011) and students from non-technical high school (Metraglia, Baronio & Villa, 2011).
All those problems relate with lacks in knowledge and ability with graphics fundamentals, that, as said above, is losing importance in education programs and it is often considered assumed before engineering graphics courses (Meyers, 2000) where, in fact, it isn't. A distinction in graphics education between 'topics' and 'tools', saying that tools are to be considered as means used for learning about the topics, should be developed (Meyers, 2000).
In contrast with the increasing of the variety of offerings in engineering graphics programs, national and international institutions are promoting the development of instruments to make national qualifications comparable and to help skills better appreciated and recognized, for example in Europe, with the European Qualifications Framework (EQF) (Metraglia et al., 2011) and in America, with the Accreditation Board for Engineering and Technology (ABET) (Barr, 2012). Both EQF and ABET identified a similar set of outcomes – knowledge, skills and abilities – that must be attained at graduation, or at an exam.
For the basics of engineering graphics, i.e. technical drawing, a tool to assess drafting skills has been proposed in coherence with the EQF structure: the Technical Drawing Evaluation Grid (TDEG) (Metraglia et al,. 2011). The TDEG takes into high consideration the difference between the ability in reading and understanding drawings and the ability in realizing it, considering fundamental the 'ability to read drawings', in contrast with Meyers (2000), that defines it a 'pertinent area impacting engineering graphics'. The Technical Drawing Evaluation Grid refers the abilities 'to read drawings' and 'to use technical drawing as a language of communication' to 8 A-levels, whilst the capability to produce correct technical drawings aimed to design synthesis refers to 8 B-levels. For each level, specific knowledge, skills and competences are described.
Among the main goals of the Technical Drawing Evaluation Grid there is to be a common self-assessment tool. (Metraglia et al., 2011). A questionnaire based on the TDEG is therefore needed to consent students to understand their preparation and to teachers to know the topics in graphic fundamentals that students consider as the hardest to understand.
However, to build a common tool of reference, the Technical Drawing Evaluation Grid should be designed coherently with the way students tend naturally to learn and cluster knowledge. The self-assessment questionnaire is so intended to understand, despite the way a technical drawing course is taught, the way students learn, so to evolve the TDEG in levels considering consistent topics rather than chunks of skills.
TDEG construction was based on a "concrete/sequential" approach (Butler (1987)), i.e. a traditional step-by-step teaching with theoretical lessons and exercises. Sadowski, Birchman and La Verne (2006) showed that that kind of approach is appreciated by male learners whilst female are expected to behave differently, because females seem to prefer an approach including study projects, experiments and discussion. The assessment grid should take into consideration those different learning styles. One of the aims of this study is to cluster the topics of the

TDEG basing on the way they are learned rather than the way are taught. The grid proposed in TDEG 2011 is expected to reflect in some way in skills self-assessment, and male and females are expected to differ.
Prior experience in engineering drawing, for example in technical high school, is expected to influence in some way the skills self-perception, and the answers in the questionnaire as well.
In this preliminary study, the first 5 A-levels and the first 4 B-levels of the TDEG were investigated. The complete TDEG can be found in the original paper (Metraglia et al., 2011). In Table 1, levels investigated and correspondent competences are reported.

Table 1. Technical Drawing Evaluation Grid – competences for the first levels

Levels	Competences (to be able to …)
1-A	Interpret the morphology of a part through its representation in views and cuts
1-B	Independently carry out the representation in views and cuts of a part
2-A	Interpret the dimensioned drawing of a part and / or the main elements of an assembly drawing
2-B	Realize the dimensioned drawing of a single part and know how to extract the parts from an assembly drawing
3-A	Recognize the threaded parts represented in a drawing and interpret the thread designation
3-B	Realize the dimensioned drawing of a part containing threaded parts and to complete with thread designation
4-A	Interpret a complete picture of dimensional tolerances and surface finishes
4-B	Realize the dimensioned drawing of a part complete of dimensional tolerances and surfaces finishing
5-A	Recognize the housing of a removable unthreaded connection in a part drawing or its presence within an assembly drawing, and interpret their designation

2. METHOD

2.1. Design

A convenience sampling of one hundred and eighty first-year engineering students who had attended the course of 'Technical Drawing' taught at the Faculty of Engineering of the University of Brescia was selected to participate to the study. Students were mailed a coded questionnaire and asked to answer self-assessment questions on their technical drawing skills. The questionnaire was mailed one week before the final exam not to bias the skills self-perception with the score of the exam. Participation was voluntary and encouraged by the chance to win one of ten 16GB pen-drives extracted by drawing lots among the participants. Participants were naïve about the purpose of the study. Students had four days to return the questionnaire completed. One hundred and seventeen students (65.0%) returned the questionnaire. Data about participants' gender and high school of provenience diploma were collected.

2.2. Materials

A questionnaire was developed by the researchers basing on the first 5 A-levels and the first 4 B-levels of the Technical Drawing Evaluation Grid. Skills and competences described for those levels were considered comprehensive of the program of the 'Technical Drawing' course taught at the Faculty of Engineering. The original questionnaire was made by 41 statements. Those statements were reviewed by five first-year engineering students and the items which seemed ambiguous or difficult to respond to were discussed with the researchers. The original item pool was reduced and revised, and the final questionnaire was composed by 35 statements. Each statement was classified by the researchers as correspondent to one or more skills within a specific level of the TDEG. That classification (see Table 3 in 'Results' section) was not part of the submitted questionnaire. The Questionnaire is reported in Appendix A.

2.3. Procedure

Participants were expressly asked to think about each statement and indicate how true it was on a 5 points Likert Scale (1 = Not True; 2 = Slightly True; 3 = Moderately True; 4 = Mostly True; 5 = True). Particularly, the instructions included the following sentence (Keller, 2006): "Give the answer that truly applies to you, and not what you would like to be true, or what you think others want to hear. Think about each statement by itself and indicate how true it is. Do not be influenced by your answers to other statements.". Participants were also asked to indicate their gender and high school of provenience diploma.

3. RESULTS

3.1. Exploratory factor analysis

A principal component analysis (PCA) was conducted on the 35 items with oblique variation (direct oblimin). The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .90, and all KMO values for individuals items were > .57, above the acceptable limit of .5 (Field 2009) . Bartlett's test of sphericity $\chi^2(595) = 2924.43$, $p < .001$, indicated that correlations between items were sufficiently large for PCA. Eight components had eigenvalues over Kaiser's criterion of 1 and in combination explained 72.50% of the variance. The items that cluster on the same components suggest they represent the self-perception of skills and competencies about: 1- Threads; 2 - Tolerances and roughness; 3 - Folding sheets and specification box; 4 - Interpreting and dimensioning elements from an assembly drawing; 5 - Dimensioning of a part; 6 - Interpreting the morphology of a part through views and cuts and consulting tables; 7 - Recognizing the correctness of views and cuts in a drawing; 8 - Removable unthreaded connections. A summary of the exploratory factor analysis with eigenvalues and percentages of the variance on the various components is reported in Appendix B.

3.2. Reliability

All the components but 'Folding sheets and specification box' had high reliabilities, Cronbach's $\alpha > .8$. 'Folding sheets and specification box' had a relatively medium reliability, Cronbach's $\alpha = .74$ – it is anyway to remark that "for ability tests a cut-off point of .7 is considered more suitable than .8" (Kline, 1999 as cited in Field, 2009). All the values of Cronbach's α for the components are reported in Table 2.

Table 2. Eight components of TDEG SAQ reliability estimates (N = 117)

Components	Reliability estimate (Cronbach's α)
Threads	.92
Tolerances and roughness	.88
Folding sheets and specification box	.74
Interpreting and dimensioning elements from an assembly drawing	.88
Dimensioning of a part	.82
Interpreting the morphology of a part through views and cuts and consulting tables	.82
Recognizing the correctness of views and cuts in a drawing	.80
Removable unthreaded connections	.88

Items associated with each component are reported in Table 3 - numbers refer to the number of statement as is in Appendix A. Next to the number of each item, in brackets, it is reported the theoretical association 'statement-level on TDEG' that was made by researchers before the study, i.e. the correspondence between the specific skill described in the item and the level of the TDEG where that skill is supposed to be associated.

Table 3. Items for component from factor analysis and theoretical level assigned before the study (in brackets)

Threads	Tolerances and roughness	Folding sheets and specification box	Interpreting and dimensioning elements from an assembly drawing	Dimensioning of a part	Interpreting the morphology of a part through views and cuts/consulting tables	Recognizing the correctness of views and cuts in a drawing	Removable unthreaded connections
17 (3-A)	26 (4-A)	1 (1-A)	7 (2-A)	8 (2-A)	4 (1-A)	2 (1-A)	34 (5-A)
18 (3-A)	27 (4-A)	6 (1-B)	11 (2-A)	9 (2-A)	5 (1-A)	3 (1-A)	35 (5-A)
19 (3-A)	28 (4-A)		12 (2-A)	10 (2-A)	21 (3-B)		
20 (3-A)	30 (4-B)		13 (2-B)	14 (2-B)	25 (3-B)		
22 (3-B)	31 (4-B)		15 (2-B)				
23 (3-B)	32 (4-B)		16 (2-B)				
24 (3-B)			29 (4-A)				
			33 (4-B)				

Considering theoretical TDEG levels as factors, and clustering items for each level according to the data reported in Table 2, levels 2-A, 3-A, 3-B, 4-A, 4-B, 5-A had high reliabilities, with Cronbach's $\alpha > .82$. Levels 1-A and 2-B had relatively medium reliabilities, 1-A Cronbach's $\alpha = .72$, 2-B Cronbach's $\alpha = .76$. Level 1-B had just one correspondent statements and no reliability analysis was possible. All the values of Cronbach's α for the levels considered as factors are reported in Table 4.

Table 4. Levels of TDEG reliability estimates (N = 117)

Levels of TDEG	Reliability estimate (Cronbach's α)
1-A (1,2,3,4,5)	.72
1-B (6)	-
2-A (7,8,9,10,11,12)	.82
2-B (13,14,15,16)	.76
3-A (17,18,19,20)	.86
3-B (21,22,23,24,25)	.85
4-A (26,27,28,29)	.85
4-B (30,31,32,33)	.83
5-A (34,35)	.88

3.3. Concurrent validity (gender)

One hundred and seventeen students returned the questionnaire completed: 90 males (76.9%) and 27 females (23.1%). An independent t-test was run to compare the means for males and females for the components identified through the factor analysis. For the eight components, the variances were equal for male and female participants. On average, male participants considered their skills and competencies for all the eight components higher than female participants did.

For 'Threads', the difference between males ($M = 3.73$, $SE = 0.09$) and females ($M = 3.61$, $SE = 0.14$) was not significant $t(50) = 0.75$, $p > .05$. For 'Tolerances and roughness', the difference between males ($M = 3.61$, $SE = 0.09$) and females ($M = 3.36$, $SE = 0.12$) was not significant $t(56) = 1.62$, $p > 0.5$. For 'Folding sheets and specification box', the difference between males ($M = 4.01$, $SE = 0.09$) and females ($M = 4.00$, $SE = 0.18$) was not significant $t(40) = 0.06$, $p > .05$. For 'Interpreting and dimensioning elements from an assembly drawing', the difference between males ($M = 3.54$, $SE = 0.08$) and females ($M = 3.23$, $SE = 0.14$) was not significant $t(44) = 1.99$, $p = 0.52$, $p >.05$. For 'Dimensioning of a part, the difference between males ($M = 4.23$, $SE = 0.07$) and females ($M = 3.94$, $SE = 0.15$) was not significant $t(40) = 1.76$, $p > .05$. For 'Interpreting the morphology of a part through views and cuts and consulting tables', the difference between males ($M = 3.56$, $SE = 0.08$) and females ($M = 2.99$, $SE = 0.17$) was significant $t(39) = 3.09$, $p < .01$. For 'Recognizing the correctness of views and cuts in a drawing', the difference between males ($M = 4.12$, $SE = 0.08$) and females ($M = 3.85$, $SE = 0.14$) was not significant $t(46) = 1.62$, $p > .05$. For 'Removable unthreaded connections', the difference between males ($M = 3.22$, $SE = 0.10$) and females ($M = 2.87$, $SE = 0.18$) was not significant $t(45) = 1.17$, $p > .05$.

The comparisons between genders on the eight components are showed in Figure 1. Effect sizes of gender on each component are reported in Table 5.

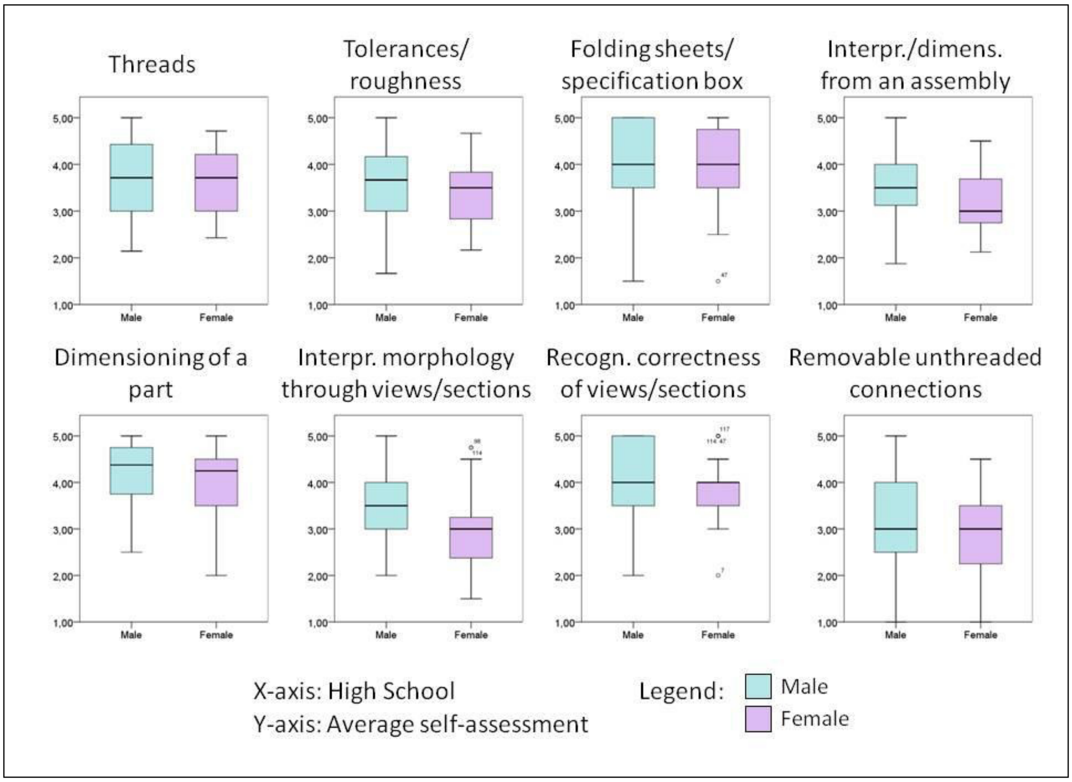

Fig. 1. Comparison between genders (Male = 90, Female = 27) on the eight components from factor analysis

3.4. Concurrent validity (high school diploma)

High school of provenience diplomas of the 117 participants were clustered in 3 groups: 1 – Scientific school; 2 – Technical school; 3 – Other school (with little or no background in technical drawing). Sixty-six (56.4%) participants came from a Scientific school; twenty-two (18.8%) from a Technical school; twenty-nine (24.8%) from Other school (Humanities school (six); Commercial school (five); Foreign (not Italian) non-technical school (six); Other schools not classified (thirteen)).

A one-way independent ANOVA (school: Scientific, Technical, Other) was run to test for differences among the means on each of the eight components for the participants considering their high school diploma. Further independent t-tests were run to test differences between pairs of groups when considered matter to concern from ANOVA analysis.

For ‘Threads’, on average, students coming from technical school ($M = 4.00$, $SE = 0.19$) self-assessed their skills greater than students from other school ($M = 3.81$, $SE = 0.14$) whilst students from scientific schools ($M = 3.55$, $SE = 0.10$) gave themselves the lowest evaluation. However, there was not a significant effect of high school diploma on the self-assessment, $F(2,65) = 2.88$, $p = .06$, $\omega = .18$. Turkey post hoc test revealed a difference between Technical School and Scientific school closed to the limit of significance (.058). A further independent t-test revealed that self-assessment for students coming from a technical school was greater than for students coming from a scientific school. That difference was significant $t(86) = 2.26$, $p < .05$, and it represented a medium-sized effect $r = .37$.

For 'Tolerances and roughness', on average, students from technical school ($M = 3.79$, $SE = 0.19$) self-assessed their skills greater than students from scientific school ($M = 3.51$, $SE = 0.10$) whilst students from other schools ($M = 3.48$, $SE = 0.13$) gave themselves the lowest evaluation. However, there was not a significant effect of high school diploma on the self-assessment, $F(2,67) = 1.21$, $p > .05$, $\omega = .06$.

For 'Folding sheets and specification box', on average, students from other school ($M = 4.36$, $SE = 0,13$) self-assessed their skills greater than students from scientific school ($M = 4.02$, $SE = 0.10$), whilst students from technical school ($M = 3.52$, $SE = 0.18$) gave themselves the lowest evaluation. There was a significant effect of high school diploma on the self-assessment, $F(2,70) = 6.95$, $p < .01$, $\omega = .30$. Games-Howell post hoc tests revealed that there was a significant difference between students from other school and students from technical school ($p < .01$). A further independent t-test revealed that self-assessment for students coming from scientific school was greater than for students coming from technical school, $t(86) = -2.38$, $p < .05$.

For 'Interpreting and dimensioning elements from an assembly drawing', on average, students from technical school ($M = 3.89$, $SE = 0.18$) self-assessed their skills greater than students from other school ($M = 3.41$, $SE = 0.14$), whilst students from scientific school ($M = 3.36$, $SE = 0.08$) gave themselves the lowest evaluation. There was a significant effect of high school diploma on the self-assessment, $F(2,63) = 3,90$, $p < .05$, $\omega = .24$. Games-Howell post hoc test revealed significant differences between students from scientific and students from technical school ($p < .05$).

For 'Dimensioning of a part', on average, students from technical school ($M = 4.06$, $SE = 0.09$) self-assessed their skills greater than students from other school ($M = 4.09$, $SE = 0.14$), whilst students from scientific school ($M = 4.06$, $SE = 0.09$) gave themselves the lowest evaluation. There was a significant effect of high school diploma on the self-assessment, $F(2,78) = 5.49$, $p < .01$, $\omega = .25$. Games-Howell post hoc tests revealed a significant difference between students from technical school and students from scientific school ($p < .01$) and a significant difference between students from technical school and students from other school ($p < .05$).

For 'Interpreting the morphology of a part through views and cuts and consulting tables', on average, students from technical school ($M = 3.77$, $SE = 0.19$) self-assessed their skills greater than students from other school ($M = 3.55$, $SE = 0.15$), whilst students from scientific school ($M = 3.26$, $SE = 0.09$) gave themselves the lowest evaluation. There was a significant effect of high school diploma on the self-assessment, $F(2,66) = 3.53$, $p < .05$, $\omega = .21$. Games-Howell post hoc tests revealed a difference between technical school and scientific school closed to the limit of acceptance value ($p = .054$). A further independent t-test revealed that self-assessment for students coming from technical school was significantly higher than for students coming from scientific school, $t(86) = -2.61$, $p < .05$.

For 'Recognizing the correctness of views and cuts in a drawing', on average, students from technical school ($M = 4.23$, $SE = 0.92$) self-assessed their skills greater than students from other school ($M = 4.10$, $SE = 0.75$), whilst students from scientific school ($M = 3.98$, $SE = 0.09$) gave themselves the lowest evaluation. However, the effect of high diploma on self-assessment was not significant, $F(2,61) = 0.83$, $p > .05$, $\omega = .04$.

For 'Removable unthreaded connections', on average, students coming from technical school ($M = 3.66$, $SE = 0.23$) self-assessed their skills greater than students from other school ($M = 3.24$, $SE = 0.17$), whilst students from scientific school ($M = 2.92$, $SE = 0.11$) gave themselves the lowest evaluation. There was a significant effect of high school diploma on the self-assessment, $F(2,65) = 4.74$, $p < .05$, $\omega = .26$. Games-Howell post hoc tests revealed a significant difference between students from technical school and students from scientific school ($p < .01$). The comparisons between high schools of provenience on the eight components are showed in Figure 2. Effect sizes of high school of provenience diploma on each component are reported in Table 5.

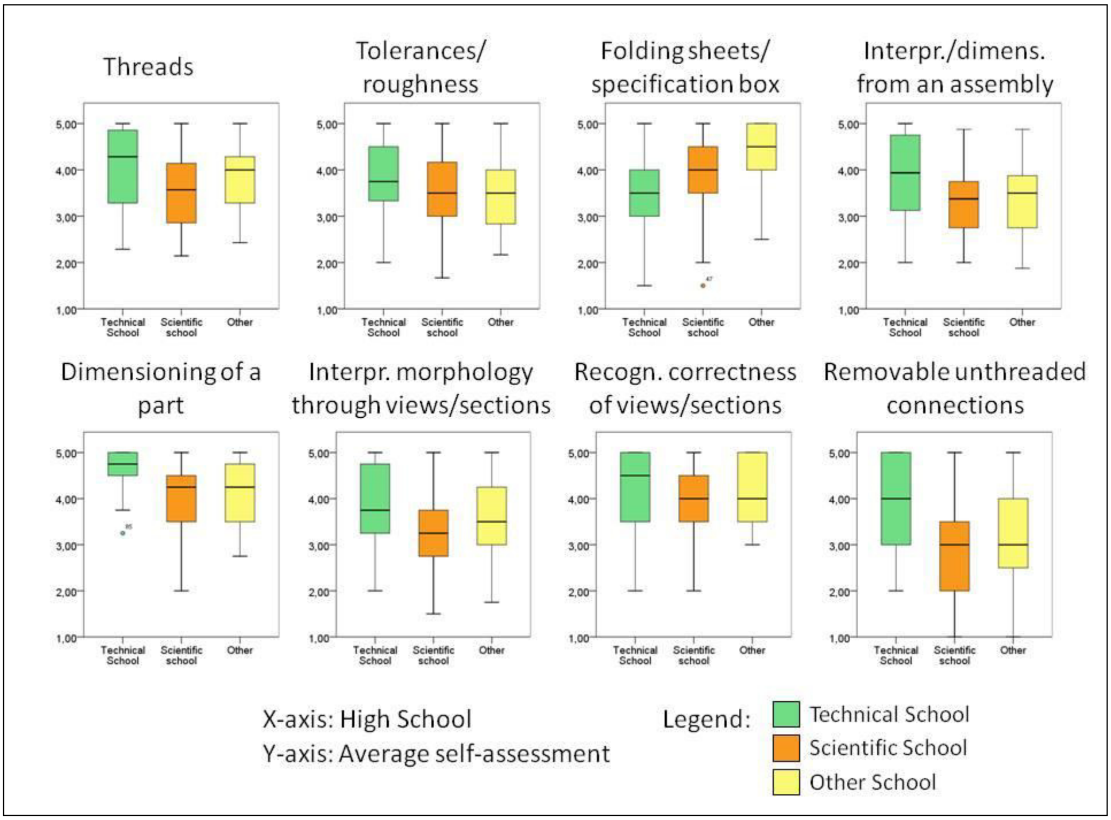

Fig. 2. Comparison between high schools of provenience (Tech. School = 22, Scient. School = 66, Other = 29) on the eight components from factor analysis

Table 5. Effect sizes of Gender and High school of provenience diploma on the components (N = 117)

Components	Effect size of Gender r	Effect size of High school diploma ω
Threads	.11	.18
Tolerances and roughness	.21	.06
Folding sheets and specification box	.01	.30
Interpreting and dimensioning elements from an assembly drawing	.29	.24
Dimensioning of a part	.27	.25
Interpreting the morphology of a part through views and cuts and consulting tables	.44	.21
Recognizing the correctness of views and cuts in a drawing	.23	.04
Removable unthreaded connections	.24	.26

4. DISCUSSION

A 35 items self-assessment questionnaire for basic technical drawing skills based on the Technical Drawing Evaluation Grid (TDEG) was developed by the researchers. One hundred and seventeen first-year engineering students completed it after attending a basic technical drawing course taught in the Faculty of Engineering of Brescia. Items were constructed by researchers to reflect skills relative to various levels of the TDEG. However, exploratory factor analysis identified eight factors relative to specific skills that don't perfectly match with the ones of the proposed original levels. In particular, students tend apparently to cluster knowledge on specific topics (e.g. threads, tolerances and roughness, dimensioning of a part, …) rather than to cluster between easier and harder things in understanding or realizing in a drawing. The sequential approach adopted to develop the TDEG is susceptible of improvement, with a redefinition of skills and competencies associated with the TDEG levels, clustering skills by topic rather than referring to a step-by-step procedure of teaching.

The proposed self-assessment questionnaire had on average a high reliability, even if there are some components that need more items to be more reliable. Moreover, dropping out six initial statements, some topics taught in the technical drawing course were not fully considered in the questionnaire, so that the self-assessment questionnaire was not representative of the whole preparation of the participants. The questionnaire showed a good concurrent validity distinguishing between genders and high school of provenience diplomas. The analysis showed that males self-assess their skills higher than females for the eight components, even if not in a significant way. For high school diplomas, the analysis showed significant differences in self-assessment among students coming from technical schools, scientific schools and other schools. Considerations about the possible reasons of those differences for each component are demanded to another research paper. A future research with a new version of the questionnaire will also study the predictive validity of the questionnaire, comparing self-assessments with the real marks students get at the exam.

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Appendix A. Technical Drawing Evaluation Grid Self-Assessment Questionnaire (TDEG-SAQ)

Items* (original questions in Italian)
1. I understand if a sheet is correctly folded and the right position of the specification box
2. I understand if views and cuts positions are incorrect in a drawing
3. I understand if views and cuts realizations are incorrect in a drawing
4. I can interpret the morphology of a part through its representation in views and cuts
5. I understand if views and cuts are not sufficient to completely represent the morphology of a part
6. I know how to correctly fold a sheet and represent a specification box in the right position
7. Given a drawing, I understand the information in the specification box
8. In the drawing of a part, I know how to insert the dimensions of its elements
9. I can understand the real sizes of a part from the dimensions in the drawing
10. I understand if the dimensions in a drawing are not sufficient to completely represent it
11. In an assembly drawing I understand what are the various elements composing it
12. I understand if the dimensions in a drawing are incorrectly inserted
13. I know the main techniques about the machining of materials
14. I know how to use and read a caliper gauge
15. In an assembly drawing I know how to add dimensions regarding encumbrance and mechanical interfaces
16. In an assembly drawing I can understand the morphology of the parts composing it.
17. I know how to represent a thread in a drawing (e.g. screw, nut)
18. In a drawing I can recognize the various threaded connections (e.g. screw, nut) .
19. In a drawing I understand if there are threaded parts.
20. I know how to derive the characteristics of threads by their designation
21. I know how to use caliper, screw pitch gauge and tables to take the threading.
22. I know how to realize the dimensioned drawing of a part containing threaded elements in front view.
23. I know how to realize the dimensioned drawing of a part containing threaded elements in lateral section.
24. I know to realize cuts of threads.
25. I know how to represent and dimensions threaded details considering the kind of connection (consulting tables).
26. I know how to add variances to dimension when the dimensional tolerance is already expressed.
27. I know how to insert, once noted, the roughness indication.
28. I understand the meaning of dimensional tolerances in a drawing.
29. I understand the roughness indications in a drawing.
30. I know how to insert a dimensional tolerance once the type of coupling is noted.
31. I know how to insert a dimensional tolerance once the functionality of the coupling is noted.
32. I know how to draw a part with dimensions and dimensional tolerances.
33. I know when no to insert roughness indications being them redundant or discordant
34.In an assembly drawing I can recognize the presence of a removable unthreaded connection.
35. In part drawing I can recognize the presence of a house of a removable unthreaded connection.

* = For all the items, the possible answers were: Not True; Slightly True; Moderately True; Mostly True; True

Appendix B. Summary of exploratory factor analysis results for the TDEG SAQ (N = 117)

Item	Comp. 1	Comp. 2	Comp. 3	Comp. 4	Comp. 5	Comp. 6	Comp. 7	Comp. 8
22	.92							
24	.76							
23	.73							
17	.64							
19	.64							
18	.62							
20	.53							
28		-.72						
26		-.64						
30		-.63						
31		-.48						
32		-.48						.41
27		-.44						
1			.89					
6			.82					
15				-.71				
12				-.59				
16				-.58				
33				-.56				
7				-.54				
29		-.49		-.53				
11				-.51				
13				-.46				
9					.71			
14					.63			
8					.57			
10					.53			
4						.65		
5						.55		
25						.50		
21						.46		
2							.87	
3							.75	
34								.84
35								.75
Eigenvalues	14.90	2.39	1.84	1.52	1.48	1.18	1.05	1.02
% of variance	42.58	6.81	5.25	4.34	4.22	3.36	3.01	2.93