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Professional Vision in Fashion Design: Practices and Views of Teachers and Learners

Professional vision is a key skill in visually-oriented professions, but its relevance to vocational education and training has only drawn limited attention from researchers. When educating fashion designers, professional vision is vital because precisely analysing clothing is required to create good products suitable for customers. In this study, we investigate what visual information must be observed in fashion design and how the professional vision of teachers and learners differs. Semi-structured interviews targeting the visual information that should be observed in fashion design were conducted with 10 teachers and 71 of their students (the latter in groups) and subjected to content analysis. Additionally, tests involving identifying and correcting clothing defects were administered to 9 of these teachers and 132 learners across three years of training to examine how looking at clothing differs between teachers and learners. Finally, two [4 by 1] ANOVAs with the level of training as the between-groups factors were conducted to examine the differences in the total number of defects identified and the number of accurate corrections suggested. Together, the quantitative and qualitative data show that professional vision in fashion design is a multifaceted skill that takes time to develop. Professional vision enables identifying the 1) different details and patterns needed to reproduce a garment; 2) defects in manufacturing, quality, and wearability; and 3) characteristics of the customer's body. The findings also suggest that as fashion designers develop their skills, they cease looking at the surface features of clothing and adopt a more holistic and integrated approach that considers how a final garment could be realised for specific clients.

Keywords: professional vision; fashion designers; vocational education.

1. Introduction

Professional vision is an essential skill in fields as diverse as archaeology, architecture, teaching, and medicine, and is employed by various professionals to recognise specific patterns and objects in complex situations (see Goodwin 1994; van Es and Sherin 2002; Pellico, Friedlaender, and Fennie 2009; Seidel, Stürmer, Blomberg, Kobarg, and Schwindt 2011; Jasani and Saks 2013). Professional vision is not merely seeing; it involves goal-oriented seeing, in which several visual cues help the viewer accomplish a specific task (Boudreau, Cassell, and Fuks 2008). Aspiring professionals, therefore, should be able to "not only see what is going on at surface level, but also to be aware of the thinking activities hidden from view" (Stengelhofen 1993, p. 92).

Several scholars have suggested that professional vision can be defined as the ability to make sense of events through a reflective visual analysis of the objects around which the discursive practices take place (e.g. Styhre 2011). This definition implies that professional vision consists of observing specific artefacts that vary according to the professional communities where they are shared. In the field of archaeology, for example, professional vision involves the ability to visually identify specific features that categorise dirt in terms of colour, consistency and texture (see, e.g. Goodwin, 1994). In the context of educating fashion designers, we argue that professional vision is relevant to the curriculum content and, consequently, to professional practice, as this skill helps fashion designers precisely analyse clothing, ultimately resulting in good product creation. When creating and reproducing new clothes, fashion designers must identify specific visual information, usually represented by a picture. Despite the importance of this skill, its practice in vocational education and training (VET) has only

rarely been investigated. Differences in discerning meaningful information have been investigated extensively in specific domains, such as teacher education (e.g. Sherin and Star 2011; Wolff, Jarodzka, van den Bogert, and Boshuizen 2015) and medical education (e.g. Hartswood, Procter, Rouncefield, and Slack 2002; Morita et al. 2008; Wood et al. 2013). However, no studies have yet explored what differences in professional vision exist in the fashion design profession. The present research, therefore, aims to study these issues by combining qualitative methods and image-based tests to advance the understanding of professional vision and to determine how it differs among teachers and learners.

In the following sections, we will introduce the general topic of professional vision in different fields, examine expert and novice differences in educational and professional settings, and address the research questions.

2. Professional Vision in Different Fields

Professional vision is the common factor that supports knowledge construction within specific communities of visually-oriented professions. This idea is sustained by several definitions of professional vision with roots in different anthropological studies. Investigating the professional practices of archaeologists and lawyers, Goodwin (1994) conceptualised professional vision as a complex series of "socially organized ways of seeing and understanding events that are answerable to the distinctive interest of a particular group" (p. 606). Goodwin describes how archaeologists often translate professional vision into the analysis and categorisation of dirt. Archaeology students are usually instructed to complete forms categorising dirt by colour, consistency and texture. However, determining the correct categorisation often requires effortful cognitive and perceptual activities that are not easy, especially for beginners. Furthermore, individual perceptions can influence this task. Consequently, professional vision becomes *perspectival* because many ways of looking at the same *object of knowledge* exist. Nevertheless, Goodwin suggested that within a professional community, observing becomes an objective activity because observers use different discursive practices (i.e. highlighting, graphic representations and coding schemes) to organise "disparate events into a common analytical framework" (p. 607).

Archaeology is not the only profession in which such practices have been studied. Since the Goodwin's seminal work, researchers have explored the existence of professional vision, and its constitutive skills and components, in several fields. For example, Grasseni (2004) investigated professional vision in the practices of cattle breeders. She described cattle breeders' observations as the ability to identify certain traits distributed among the structure, legs and mammary system of cows that attested to their high fertility, milk production and growth, as well as their canonical and codified beauty. According to Grasseni, this way of observing cows requires personal curiosity and the ability to integrate personal experiences, technical knowledge and interaction with community members. Building on Goodwin's (1994) idea of professional vision as a socially embodied, institutionalised practice, Grasseni extended the process to include "disciplining, selecting, re-interpreting and distancing oneself from one's naïve and undiscerning vision" (p. 43).

Similarly, professional vision has been widely investigated in the field of architecture and has been defined as "skilled vision" (Lymer 2009, p. 160) and "competent seeing" (Styre 2010, p. 443). Styhre (2010) investigated the double nature of professional vision as the ability to see as an architect and as a non-architect. Analysing the use of professional vision in a Scandinavian architectural firm, Styhre described this ability not only as a peculiarity of architectural expertise but also as related to the ability to see *through* the artefacts, i.e. the paper models of buildings. Indeed, beyond pointing out the importance of training architects to observe, research on this concept has shifted from a focus on "skilled" observation to "self-reflective" observation (Styhre 2011, p. 450) and "disciplined vision" (p. 257), which is a combination of formal training and reflective practice shared with the architectural community through an ongoing exchange of written and oral information.

Teaching stands among the professions at the center of attention in work on professional vision. This is seen in traditional teacher culture, wherein several scholars have developed the idea of professional vision as relevant for observing the classroom dynamics embedded in the interplay of tacit and explicit elements noticed by the teacher (Sherin et al. 2008; Borko, Jacobs, Eiteljorg, and Pittman 2008; Seidel and Stürmer 2014). For example, van Es and Sherin (2002) suggested that teachers' professional vision consists of three noticing skills: first, teachers identify the important details of classroom situations; second, they create links between classroom situations and learning principles; and third, they use contextual information to reason about the observed events. Following this line of thinking, Sherin (2007) described professional vision as selective attention and knowledge-based reasoning to understand what is noticed. Focusing on knowledge-based reasoning, Seidel and Stürmer (2014) claimed that teachers' professional vision comprises three interrelated aspects: description, explanation and prediction of classroom situations (see also Sherin and van Es 2009; van Es 2009). The work of Seidel and Stürmer (2014) has special significance because it marked the first attempt to investigate the structure of professional vision in teacher education using a quantitative approach. Professional vision has also received considerable attention within the specialised medical field, where it is seen as a means to recognise patterns and develop diagnostic reasoning (see Jasani and Saks 2013; Gegenfurtner, Siewiorek, Lehtinen, and Saljo 2013; Pellico, Friedlaender, and Fennie 2009). For example, Shapiro, Rucker, and Beck (2006) defined medical professional vision using similar components as the teaching definition did: visually identifying key data, recognising patterns (i.e. selective attention) and interpreting meaning (i.e. knowledge-based reasoning).

Finally, in the vocational field, Gåfvels (2016) used video recordings, conversation analysis and moment-by-moment methods to investigate how interactions with flowers influence vocational floristry knowledge. According to her findings, professional vision in floristry encompasses the aesthetic standards suggested by teachers and students, financial awareness when looking at flowers, and a change of perspective that considers the customer's needs.

These studies suggest that professional vision among archaeologists, architects, doctors, florists, and cattle breeders entails observing physical objects. However, teachers must also notice and reason about changing patterns, as do other professions where dynamic interactions are key, such as air traffic control (Koskela and Pallukka 2011).

Most of these studies also share an epistemological approach and framework grounded in anthropology and socio-cultural psychology, suggesting a valuable conception of professional vision

as a professional practice involving observing and then reflecting upon physical objects and dynamics within a specific context.

3. Differences in Novice and Expert Professional Vision

While the aforementioned studies primarily described the practices of expert practitioners, less has been said about how beginning learners develop these skills. The present section addresses this by reporting on studies related to novice and expert differences in educational and professional settings.

Several scholars have identified the differences in novices' and experts' professional vision by investigating the cognitive and perceptual skills underlying the careful observation of patterns and relevant details. In teacher education, scholars have investigated how novices and experts differ in selective attention, interpretation of events, and decision-making based on what is observed (e.g. Sherin and Star 2011). For example, Wolff, Jarodzka, van den Bogert, and Boshuizen (2015) created and applied a coding scheme for analysing expert and novice teachers' descriptions of classroom events. They found that both groups could identify relevant events; however, expert teachers were better able to predict classroom dynamics due to their event-based knowledge. These findings are relevant because they suggest that the more experienced teachers become, the more they develop automaticity in managing classroom problems. In later studies, Wolff et al. (2016, 2017) used a video-based and verbal think-aloud approach to investigate how expert and novice teachers interpret problematic classroom scenes. Their findings showed that novices look at more dispersed areas and are image-driven, whereas experts focus on relevant areas and are knowledge-driven. The researchers also stated that experts perform better at integrating declarative knowledge and practical experience because they combine visual and audial cues and knowledge-based processes to attribute meaning to classroom events.

At the same time, a substantial number of medical studies on the nature of expertise have employed eye-tracking methodologies to investigate novice–expert differences in professional vision (see *inter alia* Jaarsma, Jarodzka, Nap, van Merriënboer, and Boshuizen 2015; Reingold and Sheridan 2011; Kundel, Nodine, Conant, and Weinstein 2007). These studies have distinguished between novices and experts when watching specific objects: the former conduct a fast, global overview of possible irregularities, and the latter exhibit more detailed visual recognition and evaluation of irregularities (van der Gijp et al. 2016; Gegenfurtner, Lehtinen, and Säljö 2011; Reingold et al. 2001). Scholars have also suggested that in medical image diagnosis and interpretation, experts' observation consists more of pattern recognition than visually searching for characteristics (see also Wood et al. 2013).

Generally, various studies have suggested that experts not only base their diagnoses on an expansive body of declarative knowledge but also develop skills allowing them to recognise patterns often invisible to the eyes of novices (Klein and Hoffman 1993; Wolff et al. 2017). Consequently, experts more quickly and precisely analyse and solve problems, are better at detecting patterns, expend less cognitive effort to take advantage of all the information available (Ericsson et al. 2006) and process complex information more quickly than novices do (Wolff et al. 2017). Moreover, experts attend to more task-relevant regions, while novices focus on elements that are more visually noticeable than relevant (D'Innocenzo et al. 2016; Roca et al. 2011). In understanding professional vision, therefore,

it can be helpful to distinguish different stages. For example, based on Hoffman's (1998) scale of proficiency, Chi (2006) proposed a scale consisting of seven stages of expertise: naïve, novice, initiate, apprentice, journeyman, expert, and master. Chi placed learners at an intermediate level on this scale and defined them as students engaged in instruction beyond the introductory level. In this classification, teachers can be journeymen who have developed high levels of competence and independence but are not yet experts.

By investigating novices' and experts' differences in two different fields, such as medical and teaching education, these studies have shown that in both fields experts focus more on task-relevant areas and are led by goal-searching strategies. However, while expert teachers use visual information to anticipate the dynamic actions in dynamic figures, medical staff are more focused on identifying anomalies when looking at static representations. Furthermore, although these studies have investigated professional vision in specific domains (e.g. biology, chess, medical and teaching education), to the best of our knowledge this question has not been addressed in vocational education and, specifically, in fashion design. We, therefore, intend to fill this gap by investigating how professional vision differs between teachers and learners in the fashion design profession.

4. Research questions

In this study, we aim to advance the literature on professional vision by exploring the specific visual information that must be observed in the context of fashion design. Furthermore, we investigate how ways of looking at clothes differ between the participants. We seek to deepen this discussion by investigating the following research questions:

1. *What visual information do teachers and learners believe should be observed in the context of fashion design?*
2. *How does professional vision differ between teachers and learners?*

To answer these research questions, both qualitative and quantitative methods are used. Specifically, semi-structured interviews are employed to show the teachers' and learners' opinions on what visual information should be observed in the context of fashion design. Image-based tests are then employed, as they are pertinent to showing how performances between teachers and learners in professional vision differ. In the next section, we will present the methods and procedures we adopted to be effectively aligned with those research questions.

5. Method

This section describes the participants in both parts of study before describing the materials used and the procedures followed. Throughout this section, the interviews are described first, followed by the quantitative test component.

5.1. Participants

Two fashion design schools in Switzerland participated in the study. Expert selection followed recommendations from the school directors, and a total of ten teachers (M_{age} = 46.2, SD = 6.61, all female) from modelling and technical classrooms voluntarily agreed to participate. We refer to teachers as expert professionals because, in the specific case of the Swiss VET, fashion design schools also act as companies, tailoring clothes for external customers. All teachers are still or have been professionals, with a minimum of 17 years of professional experience in the field.

We also recruited 132 novices (M_{age} = 16.63, SD = 1.98, 126 females, 6 males): 68 students in the first year of training, 38 in the second year, and 26 in the third year. Training fashion designers at the two schools consists of a three-year program that includes theoretical lessons and practical work in school laboratories. Learners practice professional skills under supervision in laboratories for 26 hours a week and acquire theoretical knowledge in the classroom for 7–9 hours a week. In modelling and technical classrooms, the learners are given daily assigned tasks requiring them to analyse garments and create technical drawings. The training plan of the modelling and technical school subjects demands that the learners develop observation sensitivity. When visually analysing clothes, the learners must look at specific information in ways that go beyond the technical ability required to make the three-dimensional clothing designs. Learners, therefore, are required to analyse a garment image before starting to create the corresponding technical drawing. We focused on these two school subjects, as the teachers suggested they were the best examples of practices related to the visual analysis of clothes.

5.2. Material and Procedure

To investigate what visual information is perceived as relevant for fashion design, we conducted individual, semi-structured interviews with ten teachers and seven group interviews with a total of 71 learners (40 first-year, 10 second-year, and 21 third-year learners). The average group size was ten. Before the interviews, the researchers prepared a set of questions designed to explore the relevant visual information necessary for analysing and creating clothes. This question set provided a guide, but the interviewer was permitted to add questions about relevant topics that emerged during the conversation. The aim of the interviews was partly to understand the general perceptions of the participants regarding the importance and role of visual information in fashion design, but primarily to discover what fashion designers specifically observe when they look at clothes. Examples of questions were: “In your profession, what does observing mean?”; “When you need to analyse an image of a garment with a given size before starting to create the corresponding pattern, what do you look at to understand the proportions to be reproduced? Could you please provide some examples?”; “Are there any classroom or laboratory activities requiring a specific ability to observe clothes or parts of them?” Group interviews with learners were preferred because they collected the opinions of several participants at once. Each group interview was conducted in a classroom setting and was moderated by one researcher, who encouraged and led the discussion. The individual interviews with the teachers lasted an average of 50 minutes (min = 38 minutes; max = 62 minutes), and the group interviews with the learners lasted an average of 38 minutes (min = 19 minutes; max = 70 minutes). All the interviews were audiotaped.

To measure the differences in professional vision between teachers and learners, a test was designed and administered to 132 learners and nine of the previously interviewed teachers (one was not available) in the two schools after the interviews. The test consisted of ten pictures including six categories of defects: 1) positioning; 2) wearability; 3) the cadence of fabrics; 4) folds; 5) cuts; 6) lengths. For each picture, a table with three columns was provided: 1) categories of defects; 2) defects; and 3) possible corrections. These tables were then filled out by the participants, who had 40 minutes to complete the test. For example, participants who indicated that slits opened inaccurately in the *defects* column also had to indicate the corresponding category (i.e. *cuts*) and suggest a correction to fix them (we call these *accurate corrections*). Given that each school followed its own slightly different approach, the test was modified by members of the schools not involved in the study to create a school-specific version with different pictures of similar complexity but relevant to the curricula. To assess the resulting test scores, a rubric was created by the teachers who selected the original pictures. This rubric described all the defects present in each picture, the corresponding categories, and the possible corrections.

5.3. Data Analysis

The interview data were subjected to content analysis using NVivo (Miles and Huberman 1994) to apply one macro-thematic category generally corresponding to the interview topic. This process involved three steps: first, the interview data were transcribed verbatim; second, the most salient themes were identified; third, the themes were further coded to create micro-thematic categories. Table 1 shows an overview of the macro-category for the interview analysis, its definition, and the micro-categories we derived from it.

Table 1. Coding Scheme for Interview Analysis

Macro-category	Definition	Micro-categories
Visual information	All relevant elements that should be observed for analysing and producing a garment, including the formal way to observe clothes as shown by teachers.	*Details and patterns*
		Defects
		Customer's body characteristics

The transcripts were read multiple times to ensure that the micro-categories were thematically coherent and consistent with the data. Two independent researchers performed interrater reliability analysis of the coding scheme for both macro- and micro-categories to determine the consistency among raters. A double coding of 20% of the corpus was conducted and then applied to the whole corpus using the NVivo software. The interrater agreement statistics showed a good level of agreement between the two raters (Cohen's $\varkappa = 0.86$). Discrepancies in coding were resolved by discussion.

Statistical analysis of the test data was conducted using SPSS. To make the results comparable, z-scores were computed for the raw scores in the total number of defects and corrections data set. The

raw scores indicated 78 defects (total defects present in the test, z = 5.80), and the total raw score had 68 right corrections (total right corrections present in the test, z = 5.92). Two (4 by 1) between-groups ANOVA (year 1, year 2, year 3 and teacher) were conducted on the number of defects identified, and corrections suggested. Effect sizes are reported as Hedges' *g*, and their magnitude is interpreted using Cohen's (1988) convention as small (0.2), medium (0.5), and large (0.8).

6. Findings

In this section, we report the findings from the thematic analysis of the interviews and the test results. We illustrate the micro-categories derived from the thematic analysis with excerpts from the interviews with teachers and learners. The original excerpts have been translated from Italian to English.

6.1 Relevant Visual Information to Observe According to Teachers and Learners

The category *visual information* includes all the relevant elements the teachers and learners stated should be observed to analyse and produce a garment. This category also includes the formal way to observe clothes, as described by the teachers. In the respondents' discussion, three types of visual information were found: 1) the details and patterns necessary for reproducing clothes; 2) the defects in manufacturing, quality, and wearability; and 3) the characteristics of the customer's body. Table 2 summarises fashion design visual information by the frequency in which teachers and learners mentioned it.

Table 2. Visual Information to be Observed and the Frequency of Occurrence in the Interviews

Visual information	**Teachers (N = 10 interviews)**	**First-year learners (N = 4 group interviews)**	**Second-year learners (N = 1 group interviews)**	**Third-year learners (N = 2 group interviews)**
Details and Patterns (1)	43 (mentioned by all the teachers)	10 (mentioned by 3 learners)	3 (mentioned by 2 learners)	6 (mentioned by 4 learners)
Defects (2)	4 (mentioned by 2 teachers)	30 (mentioned by 19 learners)	8 (mentioned by 3 learners)	15 (mentioned by 5 learners)
Body characteristics (3)	5 (mentioned by 4 teachers)	5 (mentioned by 2 learners)		3 (mentioned by 1 learner)

6.1.1 Details and Patterns as Visual Information Focused on by Teachers

Most of the interviewed teachers stated that observing clothes requires the ability to identify different details [1]. Details can refer to a specific manufacturing process fashion designers must recognise to reproduce a product, and to the fabric and its features that enable an effect in the final garment [2]. Furthermore, details could include the position of objects and their proportions in the garment.

> [1] Observing is to see, to know how to analyse, to identify a garment overall and in detail. If the trouser has a pocket, what typology is the pocket? Where is the pocket? The opening is in what position? What kind of opening is it? How is the garment finished, and so on? In observation,

> there is the colour, there is the quality of the cloth, of the manufacturing, the cadence of the cloth and then also its typology. (Teacher 1, School 1)

> [2] You look at an image, look at it and at certain details, the type of fabric, the shadows that they have. All these things here allow you to develop the work you need to perform. (Teacher 4, School 2)

Visual information as clothing details is also mentioned by some learners more focused on distinguishing typologies of details, such as seams [3] and fabrics [4].

> [3] There are a lot of seams and to start [to observe], you have to be able to recognise all of them. (First-year learner 1, School 2)

> [4] You have to be able to distinguish [the typology] when looking at different fabrics. (First-year learner 2, School 2)

However, whereas for the learners observing details was a matter of distinguishing between different typologies, the teachers' observations were more related to mentally disassembling all the various parts of a garment into the different patterns (i.e. technical drawings) needed to design it; this provides them with a greater understanding of the procedure that must be adopted [5]. Respondents used terms such as "imagination", "go beyond" and "anticipation" to explain how they look at the garments [5,6].

> [5] When I see a sketch, I already imagine the work procedure, so from there, I proceed to analyse the sketch. I do not just look at how the seam is positioned, but my mind is already beyond that; it already sees the finished garment. (Teacher 5, School 1)

> [6] Being able to go further is to be able to see the type of pattern you have to design and, therefore, with its steps, the distribution of its fit, cadence, and the effect that the fabric will have according to certain choices that you make. (Teacher 4, School 2)

Finally, the teachers stated that a good method for observing relevant details and patterns consists of starting by looking from the top to the bottom to identify the general aspects of clothes, particularly wearability, the clothes line, and proportions, up to focusing on decorative details [7]. The teachers suggested this process of following a line going from the top to the bottom as an instructional strategy to support the development of professional vision and as a useful method which helps the observer avoid overlooking significant information [8].

> [7] Every time that I assign them a task, for example, the pants analysis, they have a picture, and I ask them what they see, starting from the top. That is having a methodology. First, we talk about the line, and then I always start from the top to the bottom and say, "OK, I have the belt. I have the pockets. I have a flap" and so on. I try to have a method that really becomes a scheme for all the garments. (Teacher 5, School 1)

> [8] We try to give them a bit of a structure to observe, not to do sparse things, but from the top to the bottom, to try not to miss the details, in short. First, all the details and then maybe the finishes, seams, stitches, things that are more like decorative elements. (Teacher 7, School 2)

The ability to mentally transform a three-dimensional shape (i.e. the garment) into a two-dimensional image (i.e. pattern), therefore, is a considered a necessary skill in fashion design. Observation is, for the teachers, the starting point for reproducing the desired garment while, for the learners, observation is more related to details helping to distinguish between different typologies of elements.

6.1.2 Clothing Defects as Visual Information Focused on by the Learners

The findings show that the learners' opinions about visual information are mostly focused on identifying the defects in clothes [9]. Defects mentioned included the wrong position of details, the quality of the seams, and the combination between the back and the front of the fabric [10,11]. Moreover, it is interesting to note that, according to the first-year learners, observing implies identifying things that are wrong but not the good things [12], whereas third-year learners go beyond this to focus on the origin of problems in order to fix them [13].

> [9] The first thing that comes to my mind when the teacher tells us, "Look at this skirt", is to immediately look at it to see if there are any defects. (First-year learner 3, School 1)

> [10] It is even checking the opening type that should be positioned in the correct part and things like that. (Third-year learner 4, School 1)

> [11] It is also to see if you have put the fabrics properly, if you have sewn them, because when you look at them on the mannequin, you see if the defect comes from light, or if the fabric is set from behind, from right, or from down. (Second-year learner 5, School 1)

> [12] If the teacher tells us to look at this skirt, we immediately look at the defects, and then, I don't know, the right things are not told because you know they are right. (First-year learner 6, School 1)

> [13] For example, when you first test a dress or any garment, you have a general view. Maybe, you look if the hem falls crooked, if there are big defects, and then you see how you can improve or how you can eliminate the defects. (Third-year learner 4, School 2)

When optimal observation occurs, more advanced learners could also recognise the manufacturing quality and procedures in addition to the apparent beauty of a garment, putting into practice the professional knowledge behind having a "good eye" [14]. Garment quality arises from fabric, the absence of defects and manufacturing details in well-finished clothes.

> [14] Now that we are almost finished [with our apprenticeship], we look more if the seams fit well, if there are threads; that is, you concentrate more to see if it's all done well. Before having knowledge on that, we bought a shirt just because it was beautiful. Now, besides seeing its attractiveness, we also look at the quality. (Third-year learner 7, School 2)

The learners also stated that observing clothes is related to identifying wearability defects, which usually involve the wrong position of the garment on the customer or the mannequin, and the right proportions of the garment related to the customer's body [15].

> [15] We also look at the wearability, if the garment fits well, if the proportions are fine. (First-year learner 8, School 2)

Identifying defects was also mentioned by the teachers, who consider the overall result of their work once the garment is worn by the customer. In observing the defects, the teachers were, however, aware of the required complexity and highlighted the need for professional knowledge as a toolbox allowing designers to understand where and how to intervene [16, 17].

> [16] Each of us is physically different from the other, and a standard garment does not always suit well. Therefore, it's necessary to correct the garment according to the body shape. Referring to the garment observation, this is extremely important as it also requires a professional knowledge that allows you to understand where the defect is. (Teacher 7, School 2)

> [17] In any case, a collar should be assembled, then it should be worn by the customer. At that point, you can realise if it's all right or if you need to correct something. And there, observing again to understand if there is any defect and how you can improve it. (Teacher 3, School 2)

In contrast with the teachers who are more holistic in their approach and use their skilled observations to understand the garment, fashion design learners adopt an atomistic approach and are more concerned with the individual elements, rather than approaching the garment as a whole.

6.1.3 Characteristics of the Customer's Body as Visual Information Focused on by the Teachers and Some of the Learners

The customer's body is an object that must be observed to determine if a garment fits well. In this case, for both the teachers and the learners, observing meant not only scrutinising or "scanning" the body proportions but also looking at the customer's posture to choose the right garment typology to help hide, rather than highlight, some body shape irregularities [17,18].

> [17] I have to look at the customer just because I need to scan her. Observing is to scan. I have to look if the customer is lean, too lean, if her body shape is forward or backwards, if it is asymmetric, if she has a big bust, and so on. This gives me information when I have to draw the pattern. (Teacher 6, School 1)

> [18] We observe the customer, to see her body. We look at her proportions and if her waist is too high and the rest too long because in this case, we should balance it with cuts and other things. (Third-year learner 7, School 2)

Overall, teachers and learners differ in what they focus on while looking at a garment. Specifically, while teachers focused more on identifying the body characteristics to draw the patterns and details necessary for assembling the garment, learners tended to focus on possible defects in the final product worn by the customer.

6.2 Professional Vision Differences Between Teachers and Learners

The interview results showed qualitative differences in how the teachers and learners described observing clothes. The image-based tests quantitatively explored such differences when faced with specific tasks. Table 3 shows these differences by reporting on the means of the z-scores for total defects and corrections identified by the learners and the teachers.

Table 3. Means of the Z-Scores for Total Defects and Accurate Corrections Identified by the Learners and the Teachers

	Learner			**Teacher**					**95% CI**		**Hedges' *g***
	N	***M***	***SD***	***n***	***M***	***SD***	***t* (139)**	***p***	***LL***	***UL***	
Defects	132	-.20	.58	9	2.89	1.38	-13.70	.001	-3.53	-2.65	-4.70
Corrections	132	-.22	.40	9	3.34	1.28	-21.12	.001	-3.89	-3.23	-7.15

To detect more fine-grained differences, a one-way ANOVA was conducted to compare the means number of total defects identified the by the teachers and the first-, second-, and third-year learners [$F(3, 137) = 66.96$, $p < .001$]. Follow-up Bonferroni post-hoc tests revealed significant differences between the teachers (M = 2.89, SD = 1.38, N = 9) and the learners in all the three years with lower mean scores, and between the first- and second-year learners. There were no significant differences between the third-year learners (M = -.27, SD = .33, N = 26) and either the first-year (M = -.29, SD = .57, N = 68) or second-year learners (M = -.03, SD = .67, N = 38). Table 4 shows these differences by reporting on Bonferroni comparisons of z-scores defects identified by the teachers and by the learners in each year.

Table 4. Bonferroni Comparisons of Defects (Z-Scores) Identified by the Participants

Comparisons	***Total Defect Mean Difference***	***SE***	**95% CI**		**Hedges' *g***
			LL	***UL***	
First-year vs Second-year	-.32*	.11	-.61	-.05	-0.52
First-year vs Third-year	-.03	.13	-.35	.30	-0.04
Second-year vs Third-year	-.31	.14	-.05	.66	0.53
First-year vs Teacher	-3.18*	.23	-3.8	-2.57	-4.48
Second-year vs Teacher	-2.87*	.23	-3.49	-2.22	-3.31
Third-year vs Teacher	-3.17*	.25	-3.82	-2.5	-4.2

* $p < 0.05$

Considering the total number of (appropriate) corrections suggested by the learners, one-way ANOVA reveals overall significant differences among the groups [$F(3, 137) = 162.15$, $p < .001$]. Once again, post-hoc comparisons using the Bonferroni tests found a significantly higher mean of total corrections indicated by the teachers (M = 3.34, SD = 1.28, N = 9) than the learners in all three years. Regarding the learners, the results showed that the mean of total accurate corrections indicated by the first-year learners (M = -.35, SD = .36, N = 68) is significantly lower than the mean of total corrections identified by the second-year learners (M = -.16, SD = .36, N = 38) and the third-year

learners (M = -.01, SD = .41, N = 26). Although the difference between second- and third-year learners was not significant, their mean scores indicated a trend: the further the learners advance in their traineeship, the more correct interventions they proposed to fix problems. Table 5 shows these differences by reporting on the Bonferroni comparisons of z-scores corrections suggested by the teachers and by the learners in each year.

Table 5. Bonferroni Comparisons of Corrections (Z-Scores) Suggested by the Participants

			95% CI		Hedges' *g*
Comparisons	***Total Corrections Mean Difference***	***SE***	***LL***	***UL***	
First-year vs Second-year	-.19*	.08	-.38	-.01	-0.52
First-year vs Third-year	-.34*	.08	-.55	-.13	-0.91
Second-year vs Third-year	-.15	.09	-.38	.08	-0.38
First-year vs Teacher	-3.69*	.17	-4.13	-3.23	-6.8
Second-year vs Teacher	-3.48*	.18	-3.95	-3.01	-5.42
Third-year vs Teacher	-3.35*	.18	-3.83	-2.86	-4.52

* $p < 0.05$

Overall, despite the learners' interview statements indicating that the focus of their observations is on garment defects, the test reveals that they are not able to practice this observation effectively. Their teachers, who, according to the interviews, did not see this as the focus of observation, were more skilled at so doing when faced with actual examples. Moreover, in all three years of training, learners had difficulties identifying defects, but their skills at suggesting corrections did improve.

7. Discussion and Conclusion

This study aimed to advance the literature on professional vision by exploring participants' views of the specific visual information that should be observed in fashion design and what differences exist in the professional vision of teachers and learners. We discuss our findings concerning the two research questions raised at the beginning of the paper.

What visual information do teachers and learners believe should be observed in the context of fashion design?

As in other professions, professional vision in fashion design is intended to be an objective way of seeing shared by community members (Goodwin 1994). We found that in fashion design, professional vision involves observing three specific types of visual information for analysing and creating clothes: 1) details and patterns; 2) defects in manufacturing, quality, and wearability; and 3) the customer's body characteristics. In identifying visual information, differences can be found between the teachers' and the learners' opinions: for the latter, observing details implies distinguishing between different typologies of elements, such as the seams and the fabric, whereas the former's observation focuses more on visual cues, such as specific types of cuts, allowing them to mentally disassemble the garment into different patterns (i.e. technical drawings).

These three types of visual information are equally important in garment visual analysis, but the differences between the teachers' and the learners' opinions reveal two predominant orientations: the teachers concentrate on the starting point of garment observation—identifying the details and patterns useful for making clothes—and the learners concentrate on the final point—identifying the potential defects in the final clothes. This finding resonates with other work. For example, Wolff et al. (2017) suggested that expert teacher knowledge systems allow them to identify relevant cues for making sense of problematic events and anticipating which teaching strategies to adopt in specific situations. Although professional vision in fashion design is related to physical objects (i.e. clothes), our results show similar findings, suggesting that the fashion design experts utilised their prior knowledge to help them make sense of what they observed. The learners' limited experience and technical knowledge, in contrast, led them to focus mostly on visual information easily noticeable as defects, hindered them from identifying other relevant visual information and prevented them from converting this information into the specific actions required to produce a garment. Overall, the experts primarily looked at the garment to mentally disassemble it, indicating that, after describing what they see, they try to predict the necessary work procedure. This finding is, therefore, in line with Sherin and van Es (2009) who pointed out that expert professional vision comprises three interrelated aspects: description, explanation and prediction of situations. In sum, these findings suggest that fashion-design-related professional vision shows similar patterns to both object-oriented professions (e.g. archaeology and architecture) and event-oriented professions (e.g. teaching) that entail observing physical objects while reasoning about relevant dynamics (Seidel and Stürmer 2014; Lymer 2009).

How does professional vision differ between teachers and learners?

The interviews demonstrated that teachers and learners describe visually analysing clothes differently, and the test results confirm there is a difference in how they perform when given such tasks. This accords with other studies. For example, Seidel and Stürmer (2014) found that novices can describe classroom situations but cannot adequately interpret relevant information and predict the consequences of what is observed. We also find similar patterns in fashion design. Specifically, the test results reveal that the learners in all the three years of training have not yet achieved their teachers' ability to identify and fix clothing irregularities. In contrast, by taking advantage of all the information available, the teachers perform a more precise analysis and are better at detecting patterns. Thus, observing clothes is, in fact, a process that involves complex cognitive skills that are noticeably absent in the beginner learners who can spot defects but not see their origin. However, more advanced learners, whilst no better than first-year learners at identifying relevant defects, are better at suggesting corrections to fix the problems.

As the fashion design learners move through their training, they focus on surface features and, especially, defects in clothing, before being able to recognise how to correct such defects. In contrast, fashion design professionals are more holistic in their approach, integrating their understanding of the ultimate product with their skilled observations concerning details, defects and the decomposition of a garment into its component parts. These findings are in line with previous studies in other professions (see, e.g. Wolff et al. 2016) and confirm that professional vision is not developed as an isolated ability but involves different stages and, as such, can be trained. In fashion design, a crucial component of professional vision involves the visual-spatial skill of mentally transforming a three-dimensional shape (i.e. the garment) into a two-dimensional image (i.e. a pattern). This specific skill

distinguishes experts from novices. We, therefore, argue that this has interesting educational implications for training fashion design learners as they professionally observe clothes in VET contexts. Whether it is called skilled vision, competent seeing or embodied observation, this ability must arise from personal experience and knowledge. Educationally, this suggests that it is important to provide a set of experiences, not merely observations, through which students may develop these capacities; ideally, a gaze informed by their personal experiences and the kinds of capacities they require to make judgments about a garment. We believe that formally involving vocational schools in observation practices can foster and support the educational benefits of this multifaceted skill. This can speed the process of acquiring competent seeing and prompts the development of an informed gaze. Institutions should work on developing new training programs and new attitudes to support not only the technical skills of learners but also to encourage the development of professional vision within their practices.

We should note some limitations of this study. The small size of the teachers' sample and the origin of all the participants in the Italian-speaking region of Switzerland reduces the representativeness of our findings for the national context. Also, due to the exploratory nature of this stage of the study, it was not possible to investigate the focal zones observed by the participants based on their eye movements. Given the promising findings garnered from interviewing and testing, an eye-tracking methodology can be employed in future research to investigate how teachers and learners differ in observing specific information.

However, we believe that the findings of this study are sufficiently compelling to support further education regarding helping fashion design learners to develop their professional vision. Consequently, the next stage of our research is to create and implement instructional learning scenarios at the two schools studied. Further research is now being conducted to investigate the success of this technology-based intervention and to determine whether and how this research can contribute to the promotion of professional vision in fashion design.

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