Assessing Graphic Designers' Learning Style Profile to Improve Creative Coding Courses

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Abstract

This study aimed at assessing graphic design students' preferences for learning to help design school educators teaching Creative Coding programming courses adapt their teaching style to account for the way their students learn. The Felder-Soloman Index of Learning Styles (ILS©) was administered to 77 bachelor-level graphic design students. Compared to students in technical fields, the graphic design students differed by being considerably more intuitive, with an increased preference for active and visual learning. Based on these findings, specific recommendations and issues for educators to consider are presented.

1. Introduction

In today's software-driven, techno-centric world, the popular prevailing discourse is that everyone must learn to program. Many national and international initiatives have helped put coding and computational thinking into schools' curriculums, aided by a rapidly increasing undergrowth of dedicated programming environments tailored to suit the needs and learning situations of specific audiences. Programming has also made its entrance into Graphic Design education. Design schools across the globe are now offering programming courses, typically branded using the popularized term *Creative Coding*. These courses teach informal programming practices that enable graphic design students to create expressive visual output for use in commercial contexts.

However, being a recent addition to graphic design education, programming has not yet been taught extensively. Hence, empirically gained knowledge to help design educators navigate and operate within the intersection among graphic design, programming, and teaching is largely missing. As a contribution to close this gap, this study will assess the learning style profile of graphic designers. Learning styles are different and unique ways used by students as they prepare to learn and recall information. Incorporating learning styles into teaching plans can make learning easier and lead to better achievement. Conversely, failing to match the students' preferred learning styles risks impeding their learning. While several studies have been undertaken to assess the learning style preferences of students in many diverse disciplines, no known studies have explicitly sought to profile graphic design students. Understanding the preferred learning style of graphic design students will help design educators plan and execute enjoyable, enriching, and effective learning experiences that teach programming in a way which accounts for how graphic design students prefer to acquire new knowledge.

2. Method

Although some researchers consider the idea of learning styles a contested notion [FB05, p.58], more than 70 learning style models are described [CMHE04] with Kolb [Kol84], Honey and Mumford [HM92], Myers-Briggs [BMQH98], and Felder and Silverman [FS88] being the most commonly used. Each proposes different classifications and descriptions of learning styles.

This paper uses the Felder-Silverman learning style model (FSLSM) developed in 1988 [FS88] and updated in 2002. FSLSM is widely used in scholarly literature within science, technology, engineering, and mathematics (STEM) fields; thus, there is a large pool of studies to compare the findings against. The learning styles defined in FSLSM can be identified using the Index of Learning Styles (ILS©) questionnaire [FS00]. ILS© is an often used and well-investigated instrument generally considered reliable across disciplines [FG07, ZWA00, Zyw03]. ILS© is available as a free online test, which makes it easy for educators to deploy and interpret. This also allows researchers to verify and extend the results reported in this paper. While other studies on how graphic designers learn focus on qualitative, holistic, and procedural aspects [Cro82, Law05, Sch83], the combination of FSLSM used in conjunction with ILS© provides a quantitative, utilitarian lens through which to consider the ways students prefer to acquire knowledge.

Compared to other learning style models, which tend to classify learners into a few groups, FSLSM allows for a more nuanced profile by placing the learner on a scale between two contrasting poles across four dimensions. Each dimension can be summarized as follows [FS05]:

- "*sensing* (concrete, practical, oriented toward facts and procedures) or *intuitive* (conceptual, innovative, oriented toward theories and underlying meanings);
- *visual* (prefer visual representations of presented material, such as pictures, diagrams, and flow charts) or *verbal* (prefer written and spoken explanations);
- *active* (learn by trying things out, enjoy working in groups) or *reflective* (learn by thinking things through, prefer working alone or with one or two familiar partners);
- *sequential* (linear thinking process, learn in incremental steps) or *global* (holistic thinking process)."

Moreover, FSLSM is based on tendencies, indicating that learners, despite exhibiting a preference for a certain behavior, can sometimes act differently.

DOI: 10.2312/eged.20191027

3. Study

The study was conducted between May 2015 and May 2018. A total of 77 bachelor-level graphic design students participated: 41 males and 36 females, with ages varying between 19 and 35 years (median 25 years). All students were enrolled in intensive studio-based introductory Creative Coding classes lasting between 1 to 3 weeks at the university college Danish School of Media and Journalism (DMJX). The study and the purpose were explained to the students, who were then asked to complete the ILS© online questionnaire and submit the results. Upon completion, students were briefed about the ILS© learning modalities to allow them to make use of their test scores. The data collected was entered into Microsoft Excel and analyzed according to instructions given in [FS05, p.105]. Statistical analysis against the chosen comparison studies was not possible due to lack of exact data provided.

4. Results

Figures 1–4 depict the accumulated results of all four dimensions. The left side of each dimension pair is presented as a negative value, and the right side is positive, the encoding being from -11 to +11 in odd numbers. Following the encoding procedure described in [FS05], Table 1 lists students' cumulative results arranged according to the strength of their preference as either strong (±11, ±9), moderate (±7, ±5) or mild (±3, ±1). Furthermore, results are also expressed percentage-wise in Table 2, row A, to make them comparable with results reported in other studies.

The 77 graphic design students who participated in the study were characterized by a majority of learners who preferred highly visual, active, intuitive learning with a fairly balanced number of sequential and global learners. Remarkably, looking at the VIS/VRB dimension, 82% of the students were moderate or strong visual learners. A majority of visual learners was anticipated as most people prefer to learn this way, but for students enrolled in a design school, the ratio was hypothesized to be more pronounced, and indeed, only one student showed a mild preference toward verbal instruction. In dimension SEQ/GLO, students were more diverse. Median value resided at 1, indicating that most students had a mild preference for both. A quarter of the students (24%) showed a moderate to strong preference towards either sequential (9%) or global (15%) learning. Similarly, in dimension ACT/REF, students exhibited a wide spread in their preferred learning style. The median value was -3, suggesting that the majority of students (52%) had a mild preference toward active learning. Of students showing a moderate to strong preference in this dimension, more were active (39%) than reflective (9%). On the SEN/INT dimension, nearly half the students (46%) had a mild preference for either style, with an almost equal number of students (40%) having a moderate to strong preference toward intuitive learning.

Active / Reflective	Moderate-Strong Active	39%
	Mild	52%
	Moderate-Strong Reflective	9%
Sensing / Intuitive	Moderate-Strong Sensing	14%
	Mild	46%
	Moderate-Strong Intuitive	40%
Visual / Verbal	Moderate-Strong Visual	82%
	Mild	18%
	Moderate-Strong Verbal	0%
Sequential / Global	Moderate-Strong Sequential	9%
	Mild	76%
	Moderate-Strong Global	15%

Table 1: *Strengths of preferences.*

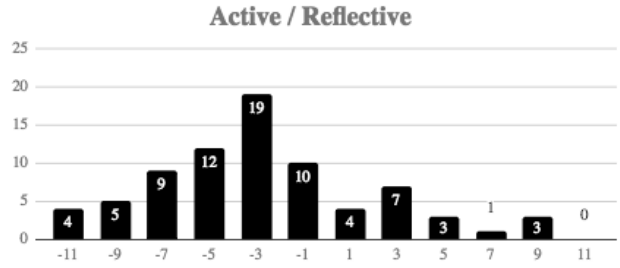

Figure 1: *Active-Reflective distribution of the respondents.*

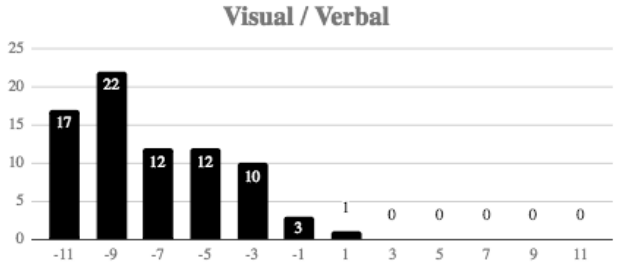

Figure 2: *Visual-Verbal distribution of the respondents.*

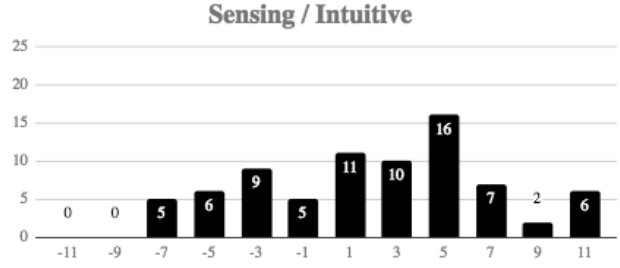

Figure 3: *Sensing-Intuitive distribution of the respondents.*

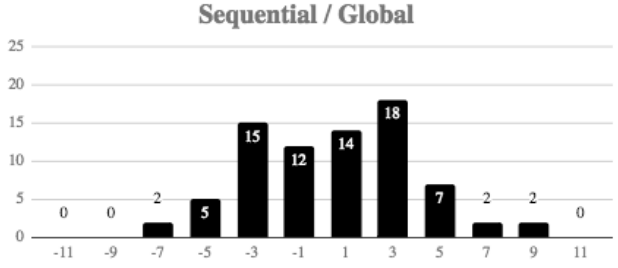

Figure 4: *Sequential-Global distribution of the respondents.*

4.1 Results compared to other disciplines

To put the results into perspective, a number of studies reporting ILS© scores across different disciplines (Table 2, rows B-H) have been used as a comparison. The studies have been selected with a desire to eliminate any skewing in the results relating to geocultural differences in teaching and learning styles.

Across all four FSLSM dimensions, results in this study correspond well with results obtained by Kolmos & Holgaard [KH08], who examined, among others, students studying Architecture & Design. This is considered indicative of a correlation between the disciplinary kinship and the students' learning profile. A considerable difference is found in dimension SEN/INT, where students in design-related studies A and B are mostly intuitive learners, directly opposed to students in technical-related studies C-G, who are mostly sensing learners. On the VIS/VRB dimension, graphic designers are generally more visual learners than students in technical fields. In fact, this study represents the highest percentage of visual learners compared to other known studies using ILS©. However, the informatics engineering students in study G show a similarly high preference toward visual learning, thereby debunking the idea that studies situated within the field of Art and Design will implicitly have a significantly larger population of visual learners in a cohort of students. Compared to the many (mostly technically oriented) studies summarized in study H, graphic design students at DMJX are almost exclusively visual (99% vs. 82%), global rather than sequential (44% vs. 60%), intuitive rather than sensing (32% vs 63%), and increasingly active (77% vs 64%) learners.

5. Implications for teachers

Assuming that the learning style profile of the graphic design students at DMJX is representative of graphic design students in general, several insights can be gained from interpreting the results using the updated Felder & Silverman teaching style model [FS88] and Felder & Soloman learning styles and strategies [FS00]. In the following paragraphs, these insights have been converted into specific recommendations to inform educators and help them plan Creative Coding courses aimed at graphic design students.

An overwhelming majority of students will have moderate to strong visual preferences. This emphasizes a need for teaching materials, demonstrations, and assignments to be highly visual. Students will not respond well to verbal instructions (i.e., passive auditorium lectures). To help students develop mental models of abstract programmatic constructs, they must be supported by visualizations [Pan16] or metaphors drawn from their pre-existing domain-specific knowledge (e.g., using nested for-loops to generate a 2D grid of shapes). Working processes should be presented whenever possible. Live coding is one particularly useful way to accomplish this that holds many benefits [BW18]. Another way to make teaching more visual is by incorporating premade interactive and editable code examples for the students to explore. This will give students an opportunity to learn programming by forming and testing ideas through immediate visual feedback.

Most students will have a mild sensing/intuitive preference, with an almost equal number of students being strong-moderate intuitive learners. Still, a sizable minority of students have sensing preferences and must be considered. It is essential that both types be catered to and that corresponding measures be taken when designing the course material. Educators should alternate between instructional methods best suited for each type, or, alternatively, introduce two parallel tracks in both teaching and assignments. For example, assignments could be designed to have a fixed goal but allow for two different ways of arriving at a solution: either through experimentation and novel use of new techniques to accommodate the intuitors, or through stepwise instructions that incorporate the use of memorized knowledge to accommodate the sensors. The formal and structured nature of programming implies that students must be presented a certain number of facts, but such sessions should be kept at a minimum. Also, the students' general bias towards intuitive learners instills hope in the sense that they should be able to cope with the abstract and mathematical concepts within programming – worth addressing at the beginning of the course to help alleviate any premature code-induced anxiety among the students.

A majority of students having a mild sequential/global learning preference indicates that educators must prepare themselves to help both sequential students who learn in linear steps and global learners who learn in large jumps. Educators must be careful to provide the big picture and relate it to previous knowledge before diving into the details, without missing a step in their explanation. In graphic design education, programming is not an objective in itself; it is a means to achieve a higher purpose, namely that of crafting visual output. Therefore, educators must relate every programming concept to the broader context of the students' study and future vocation. Sequential learners might regard assignments and exercises as individual activities, whereas global learners must be reassured that the tasks they are asked to solve will eventually form a coherent body of knowledge and skills. Finally, it might be helpful to explain to global students that they should not be discouraged from feeling "in the dark" when they compare themselves to their sequential classmates – they are both making progress, but their learning takes place differently.

Active learning is preferred by most students; however, as this is only a mild preference, teaching initiatives that call for reflective activities should also be integrated. Pair-programming is suggested as a good teaching practice [BW18], but it might be transgressive to students who prefer to quietly reflect in order for learning to

	Field	Institution	Act	Sen	Vis	Seq	N	Ref
A	Graphic Design	The Danish School of Media and Journalism	77%	32%	99%	44%	77	This study
B	Architecture & Design	Aalborg University	79%	38%	96%	32%	77	[KH08]
C	Computer Engineering & Science	Aalborg University	71%	69%	81%	47%	70	[KH08]
D	Mathematics	Aalborg University	50%	71%	79%	57%	14	[KH08]
E	Computer Science	Lappeenranta University of Technology	62%	69%	73%	41%	118	[AS10]
F	Information Systems	Massey University & Vienna University of Technology	57%	58%	87%	56%	207	[GVLK07]
G	Informatics Engineering	Polytechnic Institute of Coimbra	64%	61%	96%	74%	173	[GM10]
H	Multiple Fields	Multiple Institutions	64%	63%	82%	60%	2506	[FS05]

Table 2: *Learning Style preferences found in this study compared to those reported in similar studies.*

stick. The wide spread in the results suggests that students should be given the option to either work in pairs or work alone, depending on their personal preference. Active learners, who prefer to try things out and learn from experience, should be given objects to form a basis for their discovery. These objects might be inspirational visual material, premade code snippets, or a set of digital assets to use. To support reflective learners, educators should consider supplying additional explanatory tutorials and demonstrations, preferably as video/animations to cater to the students' visual preference. These could be viewed by students at their own pace as many times as needed until they grasped the topic presented. Not only would this leave the educator free to attend to other tasks, it might also encourage students to persist in seeking an answer. Further implications are suggested by Silverman [Sil02], co-developer of FSLSM, who later extended her research based on brain research and clinical observations. Considering the results obtained in this study, the majority of graphic designers at DMJX fit Silverman's description of "Visual Spatial Learners":

> *"They learn better visually than auditorally. They learn all-at-once, and when the light bulb goes on, the learning is permanent. They do not learn from repetition and drill. They are whole-part learners who need to see the big picture first before they learn the details. They are non-sequential, which means that they do not learn in the step-by-step manner in which most teachers teach."* [Sil02]

Silverman points out that visual-spatial abilities (associated with graphic design) are the domain of the right brain hemisphere; sequential abilities (associated with programming) are in the domain of the left brain hemisphere. Teaching programming to graphic designers, in other words, becomes a cross-hemispheric endeavor that requires educators to consider initiatives meant to access the left brain in addition to their regular mainly right-brain-oriented teaching activities. Suggested activities to stimulate the students' left brain hemispheres are verbal walk-throughs of algorithms, tests that involve math and logic, quizzes, and code-related puzzles (e.g., Parsons problems [PH06]).

6. Conclusions

The learning style profile of graphic design students at DMJX differs noticeably from that of students in technical fields. The students have a more pronounced preference towards an intuitive learning style, they are virtually exclusively visual learners, and they more strongly prefer active learning. These findings suggest that courses developed to fit the learning style profile of students in technical fields will fail at matching the preferred learning style of graphic designers. This implicitly underlines the need to develop customized programming courses and accompanying instructional methods for use in design schools.

During the study, preliminary results continuously informed the instructional design of the course the profiled students were enrolled in, leading to the development of a pedagogic method specifically made to suit the learning style profile discussed in this paper. Experiences employing this method are reported in [Han17]. Still, direct measurements of the impact of the proposed teaching initiatives described in Section 5 are needed, making it a relevant topic for future studies.

The size of the population tested (N=77) is sufficient to render the study valid for comparison with similar studies. However, to determine a broadly anchored learning style profile of graphic designers requires similar data to be collected by administering the ILS© to graphic design students in other design schools. This could be taken up as further research in this field.

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