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Design and Programming in Processing: the Creative Industries and Curriculum

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Abstract: The topicality of this study is based on the transformation of traditional and modern new media design technologies through the influence of programming in the today's media space and the widespread processing software. The objective of the study is to identify the role of processing's design in the creative industries. The research was conducted on our data obtained from the study and teaching of processing and materials of the processing's creators' website (as one of the most authoritative sources of information about this computer program). Qualitative approach allows us to study processing's design system, concept and categories; a semiotic method is used to define the processing as programming language. The key problem of the study is in contradiction: the value of processing in the creative industries and its rarity compared to other design programs in our country, unlike the United States, Germany and the UK. Processing is used not only in the field of the creative industries around the world but also for training designers programming. This study is the first research of processing's using in the creative industries and the processing's geography and media students' curriculum.

Key words: Design, processing, programming language, creative industry, curriculum

INTRODUCTION

The development and popularization of the internet and website design have transformed media space of 21st century. In the world of today, computer programs have taken over many human tasks, leaving less and less work for us to do but it doesn't mean that we can't show creativity and talent; just a form of representation has changed. Of course, there are many creatives claiming to use the computer programs to visualization but they rarely know about the computer's dependence on their professionalism and often they overestimate the computer's capabilities in the different areas. Certainly the computer allows: to edit raster-graphics in photoshop and a vector graphics in illustrator to make publishing application in InDesign and to create web applications, games, movies and content for mobile phones and other embedded devices in Adobe Flash Professional, Cinema 4D, 3ds Max, etc., so many tasks of designers day by day can to be realized by their computational counterparts.

The roots of this trend can be traced back to the mid-1990s when creatives began experimenting with HTML, Shockwave, Flash and Java applets as a creative medium (Pearson, 2011). As Marius Watz writes, predating iPhone and Android by more than a decade, the World Wide Web was the first media platform to deliver computational content, authored using tools aimed at creative people rather than computer scientists. Today become artists or designers writing code or designing hardware possible and it is an important subject of discussion and research. The dialogue between technology and design is a vital and vibrant one that shapes art and technology alike (Noble, 2012). Designers doesn't need to worry about the tasks in the design process, such as paper cutting, sculpting, construction documents, schedules, databases, modeling, rendering, animation and so forth and can now concentrate on what is most important: the concept (idea). Then the "idea" becomes a solid foundation for the development of creative industries and the creative economy because the creative humans' possibilities are the endless resource. Across the modern computer programs, everyone can be a programmer to display their creative abilities and demonstrate their own achievements on the internet.

Literature overview: In our opinion the best book to start working in the processing is "Getting Started with Processing" by Reas and Fry (2010) (founders of processing). Students can learn basic information about: processing's creation; sketching and prototyping; flexibility; family tree; all main topics theory (drawings, animation and interactive graphics) and practical examples. For anyone who just starts learning the foundation of programming, this book is ideal. "Getting Started with Processing" also had a significant impact on our curriculum for media students. The material is presented in very clear language and samples are quite simple, so its perception doesn't require a special training.

Media students can to learn programming in processing (from variables to objects), "understand the fundamentals of computer graphics, get acquainted with the processing software environment, create interactive graphics with easy-to-follow projects and etc. Other book for the beginner is "Learning Processing. A Beginner's Guide to Programming Images, Animation and Interaction" (Daniel Shiffman). The fundamentals of programming are covered gradually and slowly, for someone who studying or working in a visual field, this guide helps to understand the foundations of computing, writing code and creating media. The site of this book (http://www.learningprocessing.com) causes students interest due to many simple and clear examples. An entry-level programming book "Processing: Creative Coding and Computational Art" (Greenberg, 2007) also doesn't require any special programming knowledge. Another book from the creators of processing "Processing: a programming handbook for visual designers and artists" targets an audience of computer-savvy individuals and presents the refined curriculum form with the intention of distributing the results of this endeavor to a larger and more diverse community. Definitely this is interesting book but for a wide audience it is difficult to understand so many extensive practical and theoretical materials. Book's design is made in the processing: at first glance this original visual solution looks unusual but it is pertinently in this work devoted the processing. In principle the other books about processing also used similar design; this case attracts our attention because this design is not the individual elements in processing but a single visual system: cover, contents, miniatures of new themes and simple illustrations have a special processing's design style. The book with the other processing's design "Generative Design" (Bohnacker *et al*., 2012) originally published in German: "Generative Gestaltung" (we read this book in the original language). Book is exciting, interesting, very useful in a practical viewpoint and impressed us as soon as we saw its website (http://www.generative-gestaltung.de/). For presentation at the first lesson which familiar students with the possibilities of processing, we used excellent examples from this book. Practical material is incredibly useful when developing educational projects as well as in real creative job. Our visualization for this article is also based on the data of this book. The programming language is an artistic tool that shows us the book "Generative Art" (Pearson) with a rich and beautiful visual and verbal language. Including there are books for students and professionals like "Algorithms for Visual Design Using the Processing Language" (Terzidis, 2009); "Visualizing Data" (Fry, 2007). The audience for those books is programmers and nonprogrammers, their skill levels were enormously varied, so books are targeted at a similar range of backgrounds. Some books are devoted to important areas of Processing: "Programming Interactivity" (Noble, 2012). Websites such as processing.org, openprocessing.org, complexification.net, benfry.com and flight404.com present explorations into form, motion and interaction created in processing.

In our country, there is a group dedicated to the processing software in the popular social network "In contact" ("VKontakte": vk.com/processing_ru). Interesting that processing involves not only adults but also children. Children's book "Yasha learn programing" or "How Yasha studied programing" ("Yasha uchitsya programmirovat") by Igor' Gressus: programmingforkids. ru. The book in the form of tales and funny stories about school child Yasha gives the opportunity to learn professional programming Java-based language processing. This scientific and popular educational handbook for elementary and middle school children promotes processing. The narrative approach and enthusiastic drawing noted processing's creator Casey Reas. The coding knowledge is useful for children in the future, so we propose designing children's magazines and interactive electronic versions with processing and maybe to create a separate column in the children's edition about the basics of programming. Thus, the literature about processing covers a wide range of both a basic and specific materials, used in the educational process and creative practice.

Processing (the bridge between design and programming): A new, fascinating, flexible, multi-platform and easy-to-use programming language "processing" have been adapted for teaching design and art students how to program. Some of the stated aims of processing are to create: images, interactive programs, games, animation, interfaces, data visualization, music composition, networking, programming electronics and 3D file exporting. The use of processing in the creative industries is possible through its wide spectrum of possibilities. A processing program is called a sketch and the work process is sketching with code. Processing is completely free the source code is available and open to all comers and this programming language allows us to explore the interaction with different platforms such as HTML5, Arduino and Android. This program has come a long way of development and continues to improve. The Processing software was created in Spring 2001 by Casey Reas and Ben Fry while both were graduate students at the MIT (the Massachusetts Institute of Technology) Media Lab within John Maeda's Aesthetics and

Computation research group. The language is related to the Java, C and PostScript but with a simpler syntax and Graphics Programming Model. Processing's creators were most influenced by Design By Numbers (DBN), a language by research advisor, John Maeda which they were maintaining and teaching at the time (Reas and Fry, 2007).

In 2005, processing won the prestigious Golden Nica from Prix Ars Electronica (the electronic/cyber-arts version of an Oscar) in its Net Vision category and in 2011 National Design Award given by the Smithsonian Cooper-Hewitt National Design Museum in the category of interaction design. During this time, processing was used by thousands of people around the world and revised continuously. The processing software creators stand by pleasantry mission statement: "Processing seeks to ruin the careers of talented designers by tempting them away from their usual tools and into the world of programming and computation. Similarly, the project is designed to turn engineers and computer scientists to less gainful employment as artists and designers" (http://processing.org/).

According to Sreekumar and Greenberg processing has drawn many creative coders who makes the bridge the two cultures divide between science+technology (esp. computer programming) and the arts+humanities. Our contribution to the study of processing:

- Processing's using in the creative industries
- Processing's geography
- Processing in museums and companies: additions
- Processing's examples in the creative industries and different fields of activity
- My experience of processing's teaching and media students' curriculum
- Data visualization of this article in processing

MATERIALS AND METHODS

The research of using the processing software in the creative industries was carried out in Summer 2014. The objects of the research were materials of the processing's creators' website (as one of the most authoritative sources of information about this computer program), web-sites of creative coders that make works and commercial projects in processing was useful the book "Generative Gestaltung" (in German language) with examples of processing's most quality works. Qualitative research shows processing in its development and expressed in descriptive, analytical and predictive judgments. The gradual transition from description to a higher level of generalization features of processing has been used in the process of working with the fixed data. According to Newman and Fomicheva, working with data contains three stages:

- We break down and categorize the data into manageable segments (open coding). The main objective of this stage is to obtain a clear and orderly structure of processing, associations and regularity
- We put the data back together and making connections between and across categories (axial coding). The purpose is to find combinations of primary codes and identification of causality, the processing's topics, groups and categories
- Finally, we have a clear and selective focus and are systematically reviewing the data for that specific category (selective coding). Choice the central ideas and the concept, the processing's data selection for analysis and conclusions

The Semiotic Method (associated with semiotics/semiotic studies/semiology the study of meaning-making, the philosophical theory of signs and symbols, in this case understood as languages?/sign systems in different areas human activities) used to study the syntax, syntactic, semantics, pragmatics and hermeneutics of programming language. The semiotic approach allows us to understand the processing's action as a sign system. The objective of the research was to determine the use of processing in the creative industries. Creative industries "have their origin in individual creativity, skill and talent"; they are typically seen to include the commercial and non-commercial industries: design, photography, art, TV, radio, fashion, film, music and etc. So by studying sources we would have specific spheres that we are considering (in our case nonprobability sampling consists of eight groups: design, art, architecture, TV, film, photography, music fashion and other) (Fig. 1). In this context judgment sample based on the directed selection of the most affordable items, because the today's information about processing in the

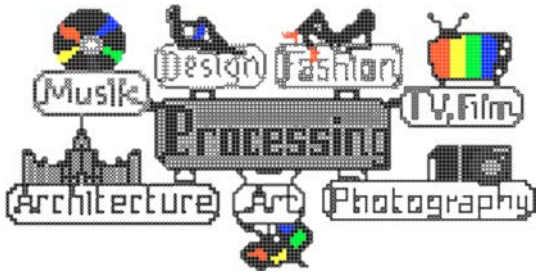

Fig. 1: Images processing sample

creative industries doesn't allow us to use methods of a probability sampling that gives the more accurate statistical inferences about the population. The popularity of processing in different areas depends on the existence of processing's capabilities, training programs, curriculum and workshops of this programming language and interest of companies.

Figure 1 was created in the processing software and illustrates the using of processing in the creative industries. In our view, it is logical to use the same computer program for our data visualization, the possibilities of which is devoted this study. The idea and basis for this image inspired by the data of the book "Generative Gestaltung" in accordance with the purpose of my work the source code has been revised and supplemented. In particular, has been introduced contour image created in Illustrator and processed in photoshop. The sphere of processing is wider than that of other programs including it can be used together with them to get the best result.

Using the processing software in the creative industries and geography: As we have already said, main source of information was the processing's creators' website; section of site "Exhibition" is "a curated collection of projects created with processing, new software added each month", these examples were our basis. We chose one hundred popular projects that were used in creative practice (information about the country and the researcher can be found by following the links). According to our research data in a significant part of cases (36%) used the processing software for design (media design; logotype; generative design; interactive design; infographics data visualization; typography; web-design). About 16% of visual artists have created in processing many different unique types of art projects (3D printed art; interactive installation; interactive projection wall). Computation architecture (the use of algorithms and computation to generate architectural form) and TV, film production in processing has proved more new capabilities for creative industries (11%). Current research data show that 8% worked with processing in photography, 7% in music and only 3% in fashion. Many users of processing currently are based in USA (44%), 23% worked in Germany and 16% in Great Britain but only 6% in China, Japan and South Korea. An illustration of the results of the research can be seen in (Fig. 1 and 2).

Figure 2 was made in processing and inspired by the book "Generative Gestaltung" too. We give an example of the program in the processing software (some lines of code):

Fig. 2: Percentage of image processing software use

```
void draw() {//the draw() function
   void key released () {//default colors from 1-8
      if (key == '1') col = color (255,0,0); //red
      if (key == 'z') line Module = loadShape ("01.svg");// load svg for
      line module
   }
}
```

Figure 3 was designed in processing through openprocessing.org; the source code has been supplemented with contour map image (made in Illustrator and photoshop). We can draw the image to the screen after adding to the sketch's data folder, creation a pImage variable and loading into the variable with loadImage() in the setup() function. The image() function and parameters determine the position (the x-and y-coordinates) and size (the width and height) of the image in the draw() function. Scalable vector graphics loading and drawing across the similar actions.

Processing in museums and companies: processing's interesting examples: Thousands of visual designers, artists and architects used the processing software. Projects created with processing have been featured at the Museum of Modern Art in New York, the Victoria and Albert Museum in London, festival «Poetry on the road» in Bremen, Garage Center for Contemporary Culture in Moscow, CAFA Art Museum in Beijing, NTT ICC in Tokyo and many other prominent venues. We collected the most popular and useful in the creative industries examples of processing, they can be found on the websites and webpages of creators (Table 1).

For processing's developers and users some of most important areas are usually: software prototyping and data visualization. Research labs inside technology companies like Google and Intel have used processing for prototyping new interfaces and services. A recent development lets users develop apps for Google's

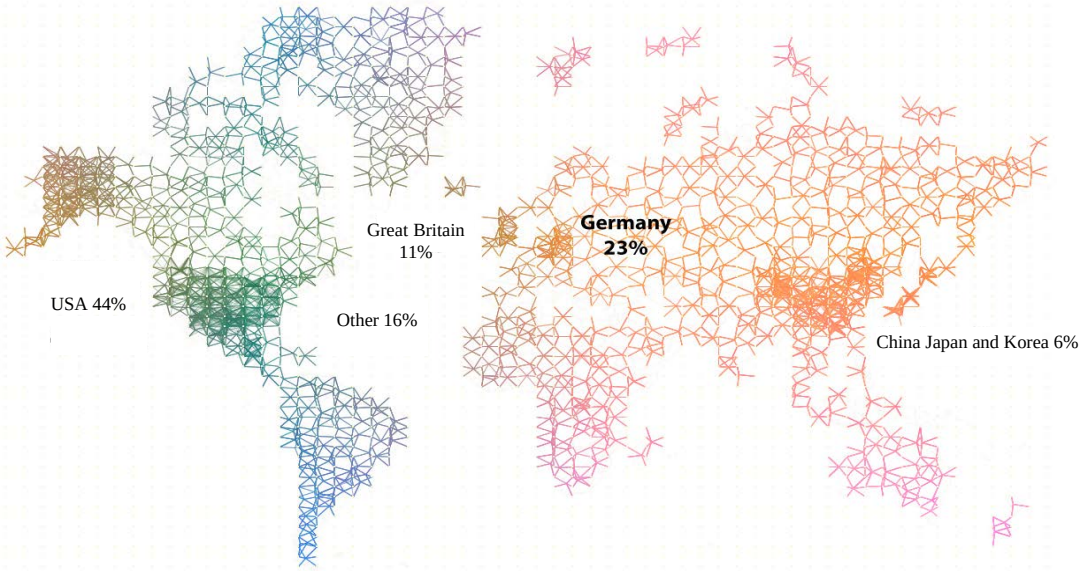

Fig. 3: Allocation of image processing software users

Table 1: Processing's examples in the creative industries and different fields of activity

Branches of processing's using	Examples	Creators
Images in posters, magazines and books	The daily newspaper "die presse"	by Lia
	An international literature festival "Poetry on the road"	by Boris Muller and Florian Pfeffer
Typography	"Generative typography"	by the "generative typography" course
Infographics	"Similar diversity"	by Philipp Steinweber and Andreas Koller
Web-design	"The sheep market"	by Aaron Koblin
Photography	"Metropop denim"	by Clayton Cubitt and Tom Carden
Music videos and films	Music video "Fall in Love" Phantogram	by Timothy Saccenti and Joshua Davis
	Film about the processing software: "Hello World! Processing"	by Ultra_Lab
Interactive installations in festivals	"One hundred and eight"	by Nils Volker
and on the street	"My little piece of privacy"	by Niklas Roy
Computation architecture	"Subdivided pavilions" and "Platonic solids"	by Michael Hansmeyer
Fashion	"Continuum"	by Mary Huang
	"News Knitter"	by Ebru Kurbak and Mahir M. Yavuz
Electronics	"Petting Zoo"	by Minimaforms

Some prominent projects include the MIT Media Lab's generative logo, the "Fox Movies" for Fox Japan and "A String" (shadowgraphs for dance performance "be silent" at the national theater of Korea)

Android OS, making processing a veritable Swiss Army knife (i.e., the app contains a set of tiny tools: this is like a software equivalent of a Swiss knife) for creative computational (Pearson, 2011). Companies including General Electric, Nokia, Samsung Mobile, MTV and Yahoo! have used processing to visualize their data, logotype and installation. For example, the New York Times Company R&D Lab used processing to the project which allows precise analysis of the structures that underlie sharing activity on the web. The NSF and NOAA supported research exploring phytoplankton and zooplankton diversity that was realized at the University of Washington as a dynamic ecology simulation. But in addition, there are many other important projects.

Processing: worldwide education and my personal experience of teaching: Processing used for create drawings, animation, interactive graphics and Integrated Development Environment (IDE) provides the electronic art, new media art and design with the purpose of teaching for artists and designers the fundamentals of computer programming in a visual media context. This program provides an opportunity for technical students an easier way to work with graphics and to learn how to program robots and countless other electronics projects. Processing is adapted for elaboration and creating visual, interactive media and the working process is playful and quick: the first programs students start by sketching on paper and then moving images into code. Thus easier for students, they can to introduce the concept of work before starting programming. Students who don't know what computer science and the programming are find it incredible surprisingly to make something appear on their screen within moments of using the software. This curriculum can also improve motivation to learning processing and has proven successful into programming

for leading design, art and architecture educational institutions and for engaging students in general computer science classes. Programming language is useful for short workshops ranging from one day to a few weeks or months. The integrated development environment is simple, so some students are able to begin programming after only a few minutes of instruction. The processing syntax, similar to other common programming languages, is already habitual to many people and so students with experience in programming can begin writing advanced syntax almost immediately. The processing software is used in computer science and programming education worldwide: often in art schools and visual arts programs in universities but it's also found frequently in high schools, lyceums and online computer training courses. Learning of media design in our country as one of popular sectors of the creative industries usually "stands on three pillars": photoshop, Illustrator and InDesign. This practical method traditionally provides students to learning software skills as well as design concepts for print publications but nowadays come in sight an interest to processing. The curriculum for learning processing in Russia was created at the Faculty of Journalism, Lomonosov Moscow State University within Chair of Photojournalism and Mass Media Technologies. Some of the first design works in processing were created in my Alma Mater by Kochkina (Project "Scanning of the time" in 2008) and Zhukova (Computer graphics in 2010); their research advisor was type designer, graphic artist, web designer and instructor Alexander V. Tarbeev (Fig. 4-6). In 2013, during the pedagogical practice I was teaching students the basics of processing; as a result, the works in the processing software by Leonova were presented in an exhibition of the projects by the "media design" students of the first semester 2013/2014. This program is interest and useful for students, they released their own creative concept and in the future will be able to apply processing to the professional activities. In addition, the program can be an interesting hobby and pastime. It is important to pay attention to certain features of the designers' study of processing, according to my personal experience:

- The students kept a great level of engagement and commitment but processing's syntax, functions and parameters isn't easy for students that haven't learn programming
- Necessary to consider the overall training level of students group
- Important to motivate students by demonstrating practical examples

Fig. 4: Image processing samples Zhukova (Computer graphics, 2010)

Fig. 5: Image processing samples Kochkina (Project "Scanning of the time", 2008)

Fig. 6: Image processing samples Leonova (Design in processing, 2013)

- Special attention should be paid to question of "Educational Example" (EE) because we saw how upset students when due to some mistakes can't work with their programs. This doesn't happen when they can turn to the "EE" and the work with "EE" promotes to learn the correct syntax
- There is no educational literature in russian language, that makes processing difficult to study
- There isn't special training material that focuses on media students not only in Russia but also abroad. Surely this is a big problem because only during lessons you can see how you need to convert the curriculum for the audience
- Better to make a sketch on paper before create the image to the screen

- The coordinate space is not easy to submit for students and they need a handouts and manuals, in particular, some moments cause the students confusion and complexity: coordinates system, radian and degrees measurements, variables, repetition and arrays
- First sketches students can do in the first lesson but the functions necessary to write on the board or give students a memo
- Students in the first lesson invent their own ways of processing programs in this case the individual approach is important to help them realize their creative projects

RESULTS AND DISCUSSION

Curriculum for media students: Preview story about the processing and its use in media practice with examples demonstration undoubtedly explain to students the importance of programming knowledge and will be a good incentive for the study this, difficult for humanities, material. Precise and clear wording of the work and the sample are half the battle. May be used new technologies in education. Convergence principle of information and communication channels and platforms implies the use in the educational process of the newest digital equipment and digital media, so special universal class (newsroom) can promotes deep understanding of processing. Visual capabilities of programming language are important for the perception of educational material. Examples of tasks that according to the plan, must be created by media students in the classroom, better to show at the beginning of the lesson. Without examples for media students is difficult to imagine what needs to be done. One or two processing's samples (on the same topic) allow students to choose and make the most attractive work. Interesting for anyone is the "game approach" when you can to see the result of the work of interactive programs and each startup of the sketch gives different visualization. During the lesson students will be focused on a specific "Educational Example" (EE), i.e., the sample of lesson's task. Generally, for media students difficult to understand special features of processing's programming language syntax, so it's possible to give them print paper with the source code of "EE". The existence of "educational example" helps:

- To understand the task and motivates to realized it
- To check the correctness of the sketch
- To study all details within the framework of homework
- To transform the source code and get something new

Table 2: Main themes of curriculum

Curriculum	Themes
Operation and display windows of processing	Toolbar, tabs, text message area, console
Coordinate space	In any processing sketch, top left corner is (0, 0) point
Functions	Basic structure of any processing sketch
Basic and custom shapes	Line, triangle, rect, ellipse and new shapes by connecting a series of points
Color	Gray values from 0-255, color selector (RGB)
Type	Processing can display text in many fonts with the VLW format
Media	Raster images (JPEG, PNG and GIF); vector files (SVG)
Interaction	The mousepressed variable and keypressed variable
Motion	Animation basics
3D	Processing 3D basics and transformation

- To consolidate the educational material
- To save and print their codes for storage and ease of use
- To create a folder with the codes on different topics

Important to note that the topics, marked by us (Table 2) are no separately for the design project we need to have knowledge in all topics. On the first lessons we need to explain briefly the main points of the curriculum because without them students will not be able to carry out practical tasks of lessons. However, on subsequent lessons each of the topics more detail studied. All lessons include theoretical and practical part. Theoretical part is an explanation of the material, demonstration of examples (including those that are used in the practical design activity) and the selection of the sample ("EE"). At the end of the lesson, you can arrange a small test work: offer students the task on the basis of the material that passed in class. For example, on the one of the first studies it's possible to offer students to make in the processing a smiley face, i.e., "☺". Our media design students were already familiar in outline with the coordinates, shapes and functions, so they created smiley faces, interesting that works were different in terms of the shapes and color. Tests, depending on the quantity of the studied material, changes and becomes more difficult. As a result the initiative of students directed to develop their own programs and implementation of the different creative ideas. Well stimulate the job opportunity of real use for example in other educational projects. Media-design students involved in the development of design corporate identity, magazine, website and etc., so they can apply their sketches in processing for other works. Media-design students have summer practice which improves their skills but design in the processing is unknown in Russian publishing houses, editorial offices, advertising agencies and etc., so knowledge of programming in processing can contribute to the non-standard design solutions and impress future employers.

CONCLUSION

Many talented designer, programmer and ordinary people have been learning, processing and publishing their work, thus inspiring others to create works. Across the processing software coding can be liberating and creative not just structured and orderly and accessible to more people than just the techies. Processing's deceivingly simple, allowing creators to get started quickly but processing provides an incredible amount of depth for those who care to peek beneath the surface. In our study, we turned to the research of the processing in the creative industries, geography and curriculum. Our study focused on the curriculum for media students because our knowledge is based on practical experience. We draw attention to the main topics, difficult moments and problems, connected with the study of processing. The most important thing, in our view, is the development of special oriented media students' education literature both in English and Russian. Processing in creative industries is not as widespread as possible and increasing the number of knowledgeable and interested creative people can contribute to its promotion. Media students could actively apply this programming language in creative practice. Presently learning and active using of processing preclude lack of publicly available literature which clearly divided on the basic themes and focused on a specific target audience. Today many people are addicted to computer programming and publishing works on the Web in this manner they gain recognition within the community. Amazingly that there are even people who still haven't practice of processing but we believe the processing software has good prospects and bright future. So, according to our viewpoint, the most important thing about processing and design of the creative industries is not only high-profile results it's how the processing software has attracted a new generation of visual designers, artists and programmers to consider programming as an essential part of their creative practice.

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