How Smartphone Natives Can Learn Animation Principle: Introductory Animation Class for Students with No Art Background

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Abstract

This paper presents a four-year case study on animation education within an Information Media department, focusing on smartphone integration. Although animation is commonly associated with fine arts departments, its use in various visual communication contexts on digital devices has expanded. Despite the conventional premise that animation is for students with art backgrounds, Kanagawa Institute of Technology (KAIT), Department of Information Media considers it essential to teach animation basics, even to students without art backgrounds. To address this, stop-motion on smartphones is adopted as a teaching tool for its low learning cost. The paper discusses how this approach, initiated during the COVID-19 pandemic, improved the efficiency of animation education. Notably, the use of smartphones extended beyond remote learning, enhancing the outreach of animation education even in face-to-face classes. The students who participated in this course not only had high learning enthusiasm, but also submitted excellent works. The paper concludes by confirming the potential of mobile technology to enhance learning.

Keywords: No-Art-Background-Students, Education, Smartphone, Animation, SNS.

1   Introduction

There is one thing about art making which we may all agree, is that we all loved to draw at an early age. As young children, we all enjoyed being artistic, seeking ways to transfer our senses and memories to the paper medium. However, this joy often proves to be fleeting. With time, self-consciousness creeps in, casting doubt upon our drawing abilities. By the time we reach our teenage years, this self-doubt categorizes us into two distinct groups: those who continue to draw and those who abandon it altogether. Meanwhile, one common aspect of art creation, with which we can all resonate, is the fondness we held for drawing during our early years. As young children, we relished our artistic expressions, eagerly exploring ways to translate our sensory experiences and memories onto the canvas of paper. However, this joy often proves to be fleeting. With time, self-consciousness creeps in, casting doubt upon our drawing abilities. By the time we reach our teenage years, this self-doubt categorizes us into two distinct groups: those who continue to draw and those who abandon it altogether.

Meanwhile, animation courses predominantly cater to students pursuing art or film-related disciplines within art schools and film schools. Consequently, the pedagogical approaches to teaching animation often assume a foundational familiarity with the art of drawing. Hence, it becomes imperative to develop innovative teaching methods for introductory animation classes

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at our school, particularly tailored to individuals who do not engage in regular drawing practices. This requirement is underscored by the findings presented in Figure 1, where the majority of students at the Department of Information Media at KAIT reported having "No drawing habit.", among 194 students who responded to the after survey 2023.

Recognizing the growing significance of animation basics, especially in light of the increasing demand across various media platforms, we have established our animation class based on two fundamental conditions. First, our students typically do not have a good amount of drawing background. Second, they are considered the generation of "smartphone natives," which is high degree of comfort with digital technology and its integration into their daily lives.
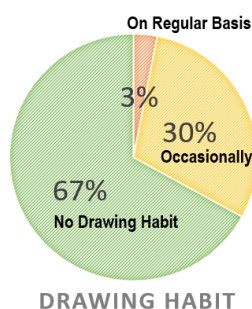

Figure 1: Drawing Habits of Students at Department of Media Information in 2023

2   Background and Preceding

The penetration of smartphones among young people is clear: according to the Mobile Society Research Institute, by the mid-2010s, when the sophomore college students surveyed were in junior high school, the smartphone penetration rate among Japanese junior high school students exceeded the majority. [1]   It should be noted, therefore, that "Smartphone Natives" is not a commonly used term, but rather a term coined by us to reflect this situation.

Utilizing stop-motion animation via digital format was proven to be very successful academically for young students, and our Intro animation class has adopted the idea since 2020. [2][3]. In this paper, we describe the details of our example using stop-motion animation on Smartphone.

In addition to the growing demand for animation in a variety of media, the context in which this paper was written is the lack of animation pedagogy for students without a background in art, and the students' familiarity with mobile technology.
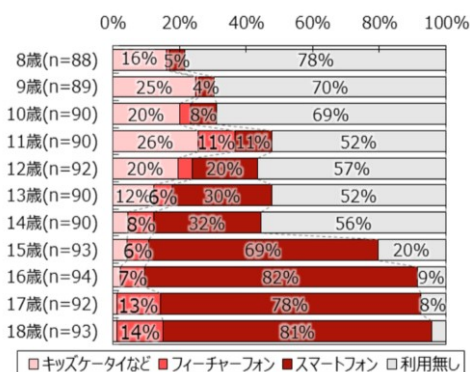

Figure 2: Smartphone ownership among children in the year 2017[1]

3   Context

A few weeks of intro animation class has been a part of the required course units which consists of 5 other classes in the spring semester of the year 2019, 2020, and 2021, and 4 other classes in the year 2022, such as game creation, sound media, etc. Students were in two 90 minutes classes in the morning each week as it shown in the figure 3. The course was initially for two weeks in 2020 and 2021, and it has been extended to 3 weeks in the year of 2022 and 2023. All 160+ sophomores who are enrolled in the department took this course in preparation for specialized courses starting the next semester. The artistic skill level of students is varied, yet in general, most of them have no artistic background. This is because our enrollment criteria is weighted in favor of certain subjects such as physics and mathematics rather than art.

Course Structure of The Entire Units					
Date / Group	Group	Group 2	Group 3	Group 4	Group 5
4/13 Week 01					
4/20 Week 02	A	B	C	D	E
4/27 Week 03					
5/11 Week 01					
5/18 Week 02	E	A	B	C	D
5/25 Week 03					
6/01 Week 01					
6/08 Week 02	D	E	A	B	C
6/15 Week 03					
6/22 Week 01					
6/29 Week 02	C	D	E	A	B
7/06 Week 03					
7/13 Week 01					
7/20 Week 02	B	C	D	E	A
7/27 Week 03					

Theme D = Animation

Figure 3: The course structure of the entire Unit

4   Objectives

This class aims to achieve the following objectives:
1.   Provide students the basic principles of animation: spacing and timing.
2.   Explain to students the importance of sense of weight and gravity in animation and its application in story content.
3.   Understand the concept of exaggeration in stylized cartoon animation.
4.   Understand the concept of replacement animation.
5.   Understand what makes a successful cyclic animation sequence in limited length of cycle.
6.   Understand 5 important key poses that makes a successful walk cycle in traditional animation.
7.   Develop the ability to give directions to team mate for accurate key posing.
8.   Understand how to set up the camera for capturing stop-motion sequence
9.   Develop the confidence to start animation project with only what you have.
10.   Expose students with various ideas among themselves under the same restriction by sharing their work on webpage.
11.   Master data management between smartphone and PC.

Table 1: Assignment Metadata

Summary	In the first week, students complete three exercises assignments using smartphone. The assignments are pendulum, bouncing ball, and roller coaster to learn gravity expression. In the second week, students make a cyclic animation that consists of 12 frames using clay or any industrial product. In the third week, students make a traditional walk cycle in pixilation.
Learning Outcomes	Animated sequences of gravity exercises and 1 12-frame-cyclic animation and animated traditional walk cycle in Pixilation from each student
Classification	Stop-motion animation; straight ahead and replacement.
Audience	All registered sophomores in the department.
Dependencies	Access to a smartphone that allows students to download and install the app "Stop-motion Studio".
Prerequisites	None. Neither drawing skill nor animation experience is required.
Strengths	Gain an experience of animation production which does not depend on any drawing skill, sophisticated camera system and editing program.
Weaknesses	Due to a limited timeframe and space of the class, the outcome would be also limited in terms of sophistication, scale and the length of the project. The number of frames is also limited to 12 for assignment 4.
Variants	The choice of material of assignment 4 is free.
Assessment	Each student submits animation footage as a movie file. Work is evaluated by its accuracy, modeling, execution of the idea, quality of animation, and composition (i.e. framing, focus, angle of the shot and proper lighting).

5   Material and Process of The Class

1) Learning about Camera Rig.

The first task is to learn how to assemble the camera rig. With a smartphone and free phone apps, setting up the camera could be possible in many ways. The three images on the left in Figure 4 are for the examples of the settings at home, as this course was started in 2020 in a middle of the pandemic COVIT-19. On the image on right in the Figure 4 is the camera rig setting at school. it shows the use of wire meshes which are available at any Doller store. They might not be the most sophisticated equipment, however, good enough for learning animation basics.

Figure 4: Examples of camera setting up at home and school

2) Learning simple 2d composition and lighting through the screen of the smartphone.

The idea of title/action safe is introduced. Students are also encouraged to capture their animation sequence from the best possible angle as well as lighting. Students are told that all their effort is evaluated by only what captured on their smartphone.

3) Learning how to use stop-motion apps.

Stop-Motion Studio was the program for this class during the past two years. This free apps allows user to capture animation frame-by frame, and provides basic frame editing function

4) Assignment 1: Pendulum.

This classic animation assignment is made even more simple by using a threaded coin with a hole in the center rather than drawing a pendulum on the paper. Students are encouraged to go through trial and error so that they can learn the spacing and timing for exaggerated movement of a pendulum with gravity.

5) Assignment 2: Bouncing Ball.

This is another traditional 2D animation exercise is which students also executed on the desk with a piece of flattened oval shaped clay. Students learn stretch and squash animation while they automatically understand the volume control of cartoonish expression of bouncing.

6) Assignment 3: Roller-coaster.

Students animate beads on along a rollercoaster path they drew in a notebook. This is the moment for them to present the sense of spacing and timing that they have just learnt through the two previous exercises. Once they do it right, the series of beads moves like a running rollercoaster, alternating fast and slow along the undulating path of the line.

7) Assignment 4: 3D zoetrope.

Students make a cyclic animation which consists of 12 frames on a disc shaped paper template. For this project, students need to understand the concept of replacement animation, a concept not used in the three previous exercises. The paper template has a circular shape consisting of 12 compartments, separated by radiation at 30 degrees from the center of the circle, and this disc turns around once it pinned with push-pin at the center. Once 12 models of sequential animation are built on the template, students take a series of photos. The disc must turn exactly 30 degrees
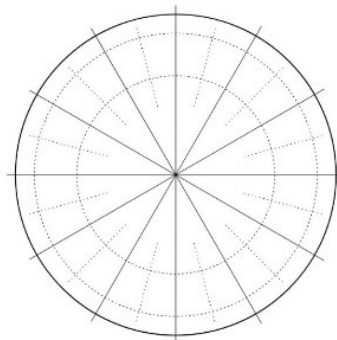

Figure 5: 3D zoetrope template for animation cycle in 12 frames

after each capture. The students' smartphones are stabilized on a tripod

8) Learning how to export movie file.

Once their animated sequences look successful, students export movie file from the apps to submit their assignment.

9) Assignment 5: Walk cycle in Pixilation

Students will create a traditional walk-cycle animation, viewed from the side, consisting of typical five frames of key poses on the famous text book by Richard Williams [5]. For this project, students need to understand that "walking is the process of catching yourself [5] just in time by taking one step with each foot before falling over and falling flat on your face." This practice is usually taught by drawing on paper over a couple of weeks for this one walking cycle assignment. However, Considering the comfort level of the students in the drawing process and its learning cost, we used a pixilation [4] method of photographing themselves and converting a series of poses as a GIF animation. After a lecture on the five key poses, each student works in pairs with another student. One student plays the role of the puppet and the other the animator and camera-man, switching roles for the second run. The process of filming requires the students to strike difficult poses, such as "Up poses" in which the entire body weight is being held only one toe and the body moves forward in the air. By the end of the class, students are expected to be physically aware of the weight shifts and body imbalances that occur with each step they walk.

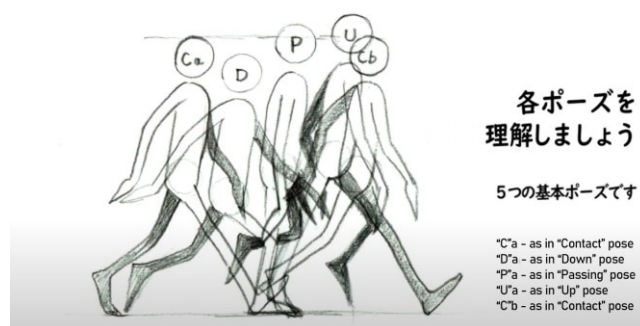## 5.1 About understanding Walk Cycle

Figure 6: 5 key poses of traditional 2D walk cycle

The walk cycle is the most basic of character animations, yet it is actually quite complex and challenging, especially for beginners. If you mechanically swap a character's left and right legs, a correct walk cycle cannot be created by splitting the animation into two parts. It is necessary to correctly grasp the movement of the joints, the shift of the center of gravity to each leg, the position of the hips and head, the relationship between the stride length and the position of the hips, and many other factors. And since there are as many different walk cycles as there are people, and since a person changes the way he or she walks depending on mood, physical condition, and the circumstances of the moment, there are countless types of walk cycles as the variety of viewing angles is considered. However, the first thing any animator absolutely must learn is, the walk cycle, which consists of five key poses of the human figure, and we refer to Richard Williams' instruction manual.[5] First, we need to understand that the character takes one step and shifts his weight, which is broken down into five basic poses, and then we need to add three more drawings for the second step, which is basically in the same silhouette as the first five poses. The walk cycle would be completed with the second step, with takes additional three drawings which have the same silhouette with switched legs and arm position as the first step, 8 in total. In order to make a proper walk cycle, the basic poses need to be understood theoretically, which is why they are not easy to master even for art school drawing-skilled, observant and aesthetically discerning students. On the other hand, even those who have not developed an eye for drawing can create a spectacular walk-cycle animation of a character, drawing level aside, as long as they understand the five basic pose forms and the sequence and repetitive rhythm of the multiple poses. The 5 key poses are shown in the figure 6 above.

Figure 4: Walk Cycle in Pixilation by Students

5.2 How class goes all together for learning Walk Cycle – Round One for the first cycle

Prioritizing the idea "Understanding the concept and the mechanism," the students were asked to perform the five poses of the walk cycle to photograph, in pair work exercises to understand and remember the center of gravity balance and the silhouettes physically. In the pair work, one takes a role of puppet, and the other serve as an animator and camera man. Students swapped roles in pairs while each pair complete two walk cycles. For the first cycle, the method was that whole class to take a picture all together in the same pacing. Around 20 pairs, each consisting of 36-44 students per class, were photographed simultaneously in the same pose. The animator/camera-man had the puppets stand against a wall and was asked to recreate the same pose as the reference, giving instructions on the position of joints and body tilts to the nearest centimeter. The puppet, sensing the imbalances and muscular tension that the pose brings to the body, strives to achieve the ideal pose and maintains the position until a photo is taken to the satisfaction of his/her partner. It was noted that the team does not move on to the next pose until all teams have been photographed. The order in which the poses are taken is not in chronological order during animation playback, but follows the efficient production order in which traditional animators work. It is the order of 1) Contact-a, 2) Contact-b, 3) Passing-a, 4) Up-a, 5) Down-a, 6) Passing-b, 7) Up-b, 8) Down-b. (The order of Up and Down can be interchanged.) The pairs that progress quickly have

to wait for the pairs that work slowly to finish taking pictures, so there is a good amount of waiting time. Although we were expected some complaints about this, we have not heard any complaints from the approximately 360 participants. Perhaps some of them observed how others posing during the waiting time to reflect on their own work and find areas for improvement.

5.3 How class goes all together for learning Walk Cycle – Round Two

For the second cycle, students are asked to take pictures of series of reference image provided by instructor with their smartphones, then to work at their own pace, using the app's onion skin function (which allows them to pose with the reference image). The students were asked to work at their own pace once they obtained all reference images. However, in order to ensure that all students capture useful reference material at a stable angle of view, only this part still needed to be done in sync for entire class in front of instructor's screen, on which the 8 images were switched accordingly.

Instead of distributing printed materials, A smartphone on a tripod is set up in front of the monitor to take a series of sequence in sync with others. Pairs that fell behind in taking pictures need to report and request the poses they had missed, in a way that interrupting the flow of progress for the entire class. Interestingly, these "work slow students" were able to answer in accurate manner which pose they wanted to be shown, to the question by the instructor which key pose they need. They answered by referring to the exact name of the pose, such as " Up-b, please," or "I missed a for Passing-a. In other words, through a series of learning processes, the students understood the name, silhouette, and sequence of each pose, i.e., the mechanics of the walk cycle, spending two-hours in the morning class. As someone who spent three weeks length of teaching on single walking cycle as a 2D traditional assignment on paper at an art school, this progress in Dept. Media Information was significant. The submitted assignments were mostly good except a few among about 102 teams in 2023. As someone who spent three weeks length of teaching on single walking cycle as a 2D traditional assignment on paper at an art school, this progress in Dept. Media Information was significant. In the Intro Animation class at CSULB in 2018, successful walk cycles were merely 13 out of 21 submitted work. The class was taught as a drawing assignment spending for 3weeks only for walk cycle, of which successful work rate being shown in Table 3 at the end of the following chapter.

6   Reaction and Outcome

In 2020, 122 out of 134 attendees (and 161 out of 169 attendees in 2021) submitted Zoetrope variations and that has made a diverse and spectacular library [6] since then. New Assignment of Walk Cycle in Pixilation was added from 2022, and 170 students out of 174 in 2022, and 200 students out of 204 in 2023 submitted their walk cycle in GIF animation format as some of the samples are shown in the figure 4.

Also, in the common questionnaire for the entire course at the end of the semester, 22.9 % of attendee chose this class as "most enjoyable exercises" among 6 classes. This was a big improvement over the previous year (2019) that was only 6%. In 2019, PC was used for animation assignment. Consider to their low confidence level that was indicated as it shown below, the overall negative reaction was low but high in "the most enjoyed class" rate which is considered as their quality of learning experience. Although further more survey should be needed, the increase of the figures could be an indication of that use of Smartphone raised students' joy level and creative freedom on assignments.

Figure 5: 3D Zoetrope Library by students

Table 2: Evaluations by Students at the end of the semester 2019-2022

	2019	2020	2021	2022
Responses (%) from whom chosen as *The Most enjoyable class among 6*	5.6%	22.9%	23%	28%

Based on the numbers above, it is fair to state that the 11 class objectives were mostly achieved.

A gallery page of the 3D Zoetrope was initially created on SNS for encouraging reactions among students, since they could not meet in person in 2020. However, the students in the class 2022 also actively referenced the library, commenting "helpful to have access to see what prior students have done".

Since all students operated within the same set of rules and guidelines for each project, their work represented a blend of original concepts and inspiration drawn from one another's endeavors. Even in instances where a student attempted to replicate someone else's work entirely, no two works were alike due to the imperfections of the human hands (in a good way). On the whole, the 3D zoetrope assignment of this nature conveys the impression that the encouragement of idea application and development was fostered with a permissive attitude toward emulation among students.

While it remains challenging to precisely quantify the impact of such references, it is plausible to assert that occasional similarities in the ideas behind their work serve as tangible manifestations of this influence.

In terms of the assignment of week 3, 196 students submitted, of which 161 submissions were good walk cycles. The criteria for acceptable work is on accuracy of the poses and also its timing. Table 3 shows some comparison between two teaching methods of walk cycle, one was taught traditionally with drawings at art school in California by the author, and the one is at KAIT with smartphone. The drawing walk cycle is based on exact the same 5 basic key poses, using 3 weeks in art department of California State University. The length of the class is the same 3 hours, and

students are also allowed to work at home while students at KAIT spend only 3 hours. This traditional walk cycle is a full animation of which film rate12 fps, while the one at KAIT is 6 fps. As the consequence, the number of the images=drawings for one walk cycle of art students is 16 while students at KAIT use only 8 images for one walk cycle. Therefore, it though it might not be totally fair to simply compare two cases as the background of the class rooms are very different from each other, however, it still shows that most of students at KAIT performed the shape of the each pose in right order, which are crucial to make a successful walk cycle while less accuracy of the timing shown by art students. Their beautiful drawings are incomparable to quick pixilation walk cycle, however, the end product needs a right structure as a complete walk cycle. This is not statement but merely the impression by experience, that due to their heavy work road for drawings, they could get caught in details getting lost in a bigger picture..

Table 3: Successful work rate in Walk Cycle assignments in two teaching methods

	Accuracy of poses	Accuracy of timing
The class taught traditionally with drawings at CSULB (2018) * one cycle consists of 16 poses	15/21 (71%)	13/21(62%)
The class taught with smart-phone at KAIT (2023) * one cycle consists of 8 poses	161/196 (82%)	181/196 (92%)

CSULB: California State University of Long Beach

7   Discussion

Questionnaires should be conducted consistent manner over the years in order to study solid relation between cause, effect and conditions which could lead to quantifying the effect of teaching methods.

Also, it might take some more years to see if the teaching methods impact the production ability of students. As most of our students choose research project over production project to fulfill their graduation requirements so far. If the population who choose animation related project for their thesis increases in following year, we can analyze the trend more closely. Referring the books of *Graduation Research Summary* of Dept. Information Media [7], the number of thesis projects in the past three years in which the keyword animation was used is noted in the Table 4 below. Although there are a certain number of animation-related theses indicates students' interest in animation, the total number of animation-related thesis in 2022 by students who participated the first animation class with smartphones in 2020 is 15, among total 142 in the population. There is still no significant amplification compared to the 20 in 2020 (population 112) and 12 in 2021 (population 140). However, according to the most recent Graduation Research Interim Report for 2023 [8] which is by students who attended the animation class with smartphone in 2021, 25 of ongoing animation-related research projects (population 144) were submitted. We will continue to monitor future developments.

It would be ideal to conduct similar exercises and questionnaires with art college students to examine the educational efficiency on the week 03 assignment. Therefore, a collaborative study with an animation instructor who teaches at an art school is being discussed, and under consideration for another research in 2024.

Table 4: Number of the thesis of animation related topics in 2020-2023

	2020	2021	2022	2023
Number of the animation related thesis project	20/112	12/140	15/142	*25/144

*the figure under 2023 is still not final as it is from *Interim Report*

8   Conclusion

As a result of conducting this series of tasks, students learned that not all animation production necessarily requires drawing skills and access to sophisticated equipment. By understanding the basic principles of animation, students understood how to modify the animation to improve the outcome. As it described in the previous chapter MATERIAL and PROCESS, the classes were extended to 3 weeks (from 2 weeks) since the year 2022, with the additional assignment for the 3rd week "pixilation walk cycle", which also requires no drawing skill. We hope that this experience will help students to advance further creative projects they will be involved in in the future. In addition, we received comments that they learned the joy of making animation and also enjoyed diversity as well as similarity among their work on the gallery built on SNS. As the quality of the camera on the phones is decent, teaching filmmaking (including animation) should be efficient outside of film schools. The concept of teaching motion-pictures could be widened as we see the rapid growth of the population of Smartphone owners.

Acknowledgement

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