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The Effectiveness of Animated Learning Video for Preschooler: A Literature Review for Developing the Instrument of Measure

Rizki Riandini Ardhiana[1] & Achmad Syarief[2]

[1] Master in Design Programme, Faculty of Art and Design, Bandung Institute of Technology
[2] Research Group of Human and Industrial Product, Faculty of Art and Design, Bandung Institute of Technology
Email: [1] al.ardhiana@gmail.com & [2] asyarief@fsrd.itb.ac.id

Abstract. Within the first five years of human life, it is important to provide the best stimuli for developing ones' brain capabilities. The emerging trend of digital interaction may hinder this development except by properly use them for learning. Although various studies on the application and development of digital media for children's learning have been explored, no adequate instrument for measuring the effectiveness of its use is found. This paper reviews usage of animated digital media through the lens of science of learning, theories of preschool children development, RAD learning and Lieberman's theories of playfulness in order to lay theoretical foundation for developing instrument to measure the effectiveness of animated learning video for preschooler. Three main aspects were discussed: appearances, contents, and vibes, with a total of 19 (nineteen) measurement items.

Keywords: *animated learning video, instrument for effectiveness measurement, preschooler*

1 Introduction

The education of preschooler is crucial according to many studies. The human brain and abilities develop rapidly in the first 0-6 years (Golden Age). It was stated by Dodge and Heroman in [1] that developmental stages have a certain time span, some lasting long enough while some have a shorter time span. The ability to see is built by the brain in the first 3-4 months, it must be given sufficient stimuli from parents and the environment and it is necessary to check the condition of the eyes at birth and after the baby is 6 months old. Therefore, at this age, the part of the brain that absorbs the most energy is responsible for vision, spatial reasoning, and action. The energy needed by the brain continues to increase until the age of four and begins to decline from the age of 9 according to Amodt and Wang in [2]. According to Piaget, the age of 0-2 years is a sensory-motor stage, children begin to understand the existence and concept of cause-and-effect. At the age of 2-7 years, they enter the pre-operational stage, namely the increase in symbolic thinking skills which is indicated by the ability to describe

the environment in the form of words and pictures. The effective period of language learning is in the first 0-5 years [1]. At this time, children will find it easier to learn multilingualism than if they were introduced to other languages in the following years. Stated by Aamodt and Wang in [2] at the age of 3-8 years, the child's brain requires about twice the energy used by the adult brain. The great potential that children have in the early years should not be missed. That's why it's important for families and adults around them to provide a series of activities and a variety of media to support the learning process of preschooler.

Currently, the trend of digital learning in Indonesia is increasing, supported by activity restrictions due to the Covid-19 pandemic. BPS states in [3] that 39.00% of internet use aims to do schoolwork. The percentage of the population who have accessed the internet by age and education level when data collection is 24.22% elementary school students, 27.28% junior high school students, and 35.61% high school students. The trend of digital learning does not only occur in formal education, but also non-formally or independently at home. Based on a survey conducted of 51 respondents in the form of parents of preschool-aged children spread across West Java and Kalimantan in [4], digital video or application providers that are often used as learning references at home include Familia Kreativa, Lebah House, Literacy Cloud, Duolingo, Khan Academy Kids, Matific, your school, and the teacher's room. There is also a wide selection of educational videos on YouTube from local and foreign channels. For the preschool segment, several channels with high ratings based on statistics released by socialblade are Nussa Official (8.48m subscribers and an average of 1.86m views per day), Little Angel Bahasa Indonesia – Children's Songs (8.16m subscribers with an average view of 5.81m per day), Kastari Sentra (3.66 m subscribers and 856 thousand views per day), and Coco and Nana (802 thousand subscribers with 1.27m views per day). Parents also provide quite a lot of screen-time for preschooler. In [4] stated that 52.94% of respondents apply screen-time with a duration 1-2 hours per day, even 11.76% allow more than 2 hours This condition exceeds the provisions of the World Health Organization (WHO) regarding the maximum duration of screen-time for children under 5 years old, which is a maximum of 30 minutes per day.

Based on the reality of a shift in learning patterns towards digital, as well as the need for digital media for preschool age children, an instrument to evaluate its effectiveness will be formed. Animated learning video was chosen because it is available in large quantities and is easily accessible directly by children, even without adult assistance. The evaluation was carried out using (1) RAD Learning and (2) the theory of applying the pillars of education to digital media.

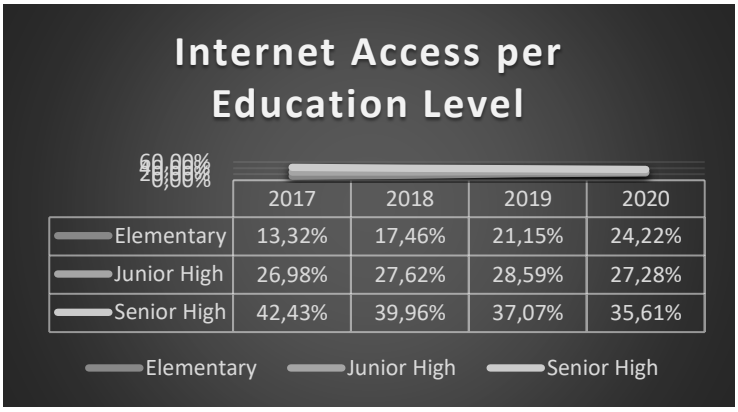

Figure 1 Graphic Internet Access per Education Level (Source: BPS Indonesia 2020.

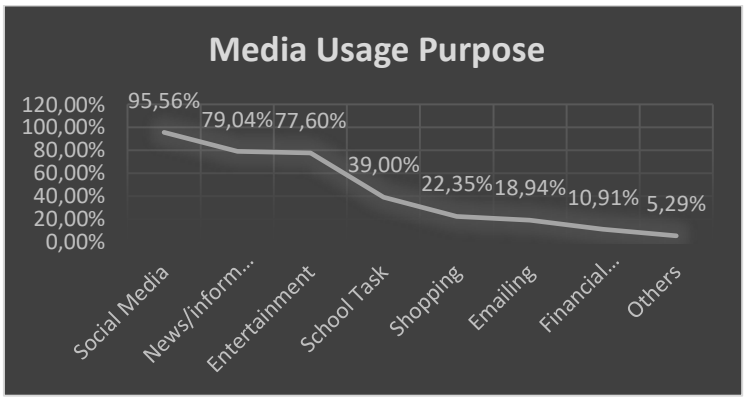

Figure 2 Graphic of Media Usage Purpose (Source: BPS Indonesia 2020).

2 Animated Video

Animated video is divided into:

1. **Computer Assisted Animation**, which is 2D animation that has a production concept similar to manual animation (hand drawing) but is done using a computer application
2. **Computer Generated Animation**, namely 3D animation which includes the process of making characters, environments, movements

3. **Stop Motion/Clay Animation,** namely animation using a series of photos of objects with slight differences in each photo, objects are often made of lego or toy wax

The use of multimedia in the learning process encourages students to be more actively involved, collaborate, think reflectively and constructively, said Ivers and Barron in [5]. Based on the Dale's Cone of Experience theory written by Anderson in [6], at least there is an increase in memory up to 30% if the stimuli given are in the form of moving images without sound, and up to 50% if they are in the form of voiced demonstrations. The highest absorption rate is up to 90% when a person experiences directly. The application of video animation in preschool age learning process has a positive impact. Result from previous researches mention that it can significantly increase the absorption of new languages by Neumann et al. in [7], improve children's numerical abilities by Dewi et al. in [8], improve children's understanding of the content provided by Maulida et al. in [9], as well as encouraging changes in children's attitudes and behavior by Kurniawati et al. in [10].

Today's most popular video service provider, YouTube, provides YouTube Kids to filter videos worth watching for children. The standards applied to video content for children are not displaying inappropriate clothing and scenes, not exemplifying negative attitudes such as having malicious intent and demeaning others, not showing dangerous scenes, content must be clearly not confusing or boring for children, and not excessively stimulating in children. YouTube Kids states in [11] that a good video must consider the development of socio-emotional, cognitive, physical aspects, sense of humor, location, as well as the environmental background and experience of the child, which of course is adjusted to the age of the target audience.

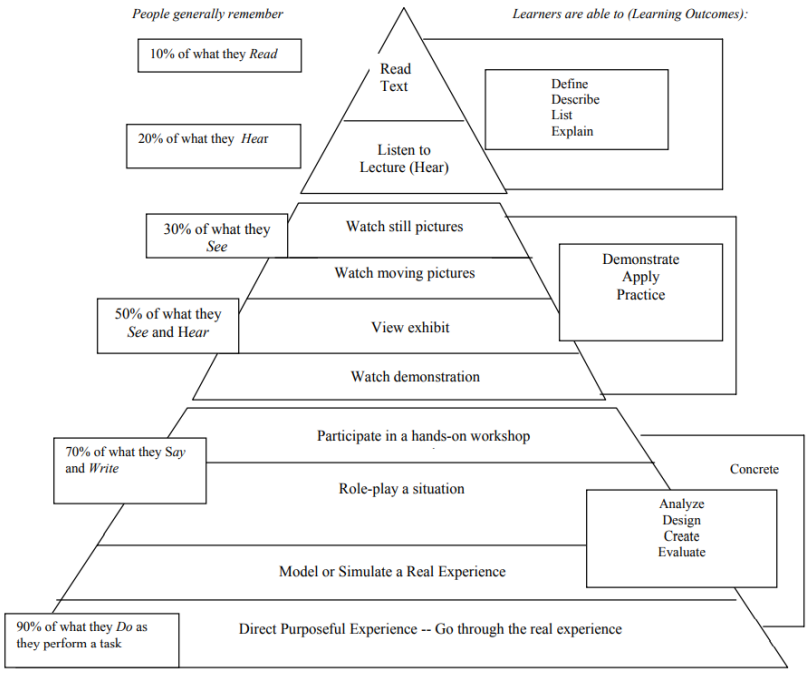

Figure 3 Dale's Cone of Experience, percentage of information absorption based on stimuli and activities (Source: Anderson).

3 RAD Learning

Adults need to understand how children think, respond, and absorb information. RAD learning explains by Willis in [12] that the success of a child's learning process is highly depends on how the brain work: (1) the Reticular Activating System (RAS) filter, (2) the amygdala filter, and (3) the dopamine hormone. When a child receives information from the outside through sensory receptors (seeing, hearing, feeling, smelling, and touching), the information passes through the RAS filter in the lower back of the brain, which is attracted to color, novelty, surprise, and unique and rare event. Here there will be a selection process whether the information received is interesting enough to be forwarded by the RAS to the next part of the brain. If information is conveyed in monotonous ways, such as one-way listening without interaction and involvement of children, then the information will be difficult to pass through this first filter. Information that is considered quite interesting will be forwarded to the second filter, namely amygdala. In this part, absorption is determined by the emotional state when receiving information. If the amygdala is in a safe-state and the child feels

positive emotions, the information will be forwarded to the reflective thinking brain, so that new knowledge can be absorbed and stored in memory.

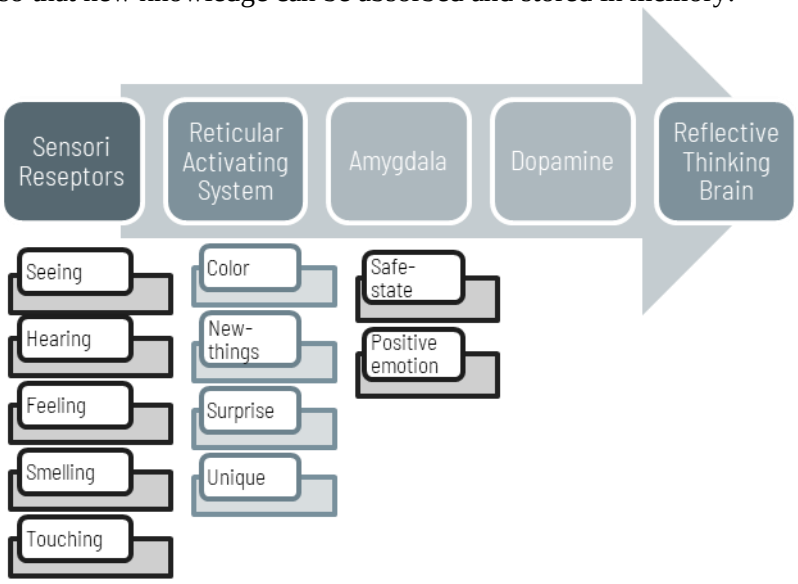

Figure 4 RAS Learning Process in Children Brain (Source: Willis 2008).

Conversely, if the child feels negative emotions such as fear, depression, and insecurity, the information is passed on to the reactive non-thinking brain. The production of the hormone dopamine is also needed to maintain a child's mood in the learning process. This hormone is produced when children have a pleasant experience, so it is very important to keep a happy atmosphere in the classroom. If the conditions are not conducive, for example the child feels bored and unfocused, then take a break for refreshing activities such as stretching, moving around the room, singing, making music, or throwing a ball.

3.1 Unique Surprise

YouTube Kids said in [11] that audiences have to feel attracted to animated learning video in the first 5-15 seconds this condition will determine whether the child will stay watching until it's finished or turn to something else. Interest can arise when there is a surprise or unique thing that grabs the child's attention as audio or visual stimuli. Audio stimuli back-sound intros, songs, and even unique words that are used as slogan with the distinctive voice of the main character. During the video, audio stimuli that also need to be considered are the selection of diction that is easy for children to understand, if you are going to introduce a new unfamiliar-word then provide support with verbal and illustration explanation. While visual stimuli can be characters that are unique, close, and can

be understood by children. Is a realistic figure who is not perfect, has positive and negative traits, has questions and concerns, and may have similar behavior or thoughts with the audience. State by Ekstrom in [13] that visual silhouette of a character represents his personality. Circles are often used for protagonists because they seem friendly, squares represent strength like a hero but also appear clumsy, and triangles are often used for villains, cunning, or aggressive characters. The use of this form can be applied to the silhouette of the body as well as the attributes used by the character. Characters should also have depth personality, strong interactions and bonds with other characters, so that children are more likely to remember them mentioned by Kricfalusi in [14].

3.2 Color Selection Effect

In color psychology, color can affect a person's physical, thinking, emotional, and psychological conditions. Previous research conducted by Tavaragi and Sushma in [15], the choice of certain colors can sharpen the senses and affect the production of hormones in the organs in the body. According to Wright in [16], the color red gives the impression of looking closer so it attracts attention first, the color is lively, friendly, and aggressive. Blue has a calming effect, clears the mind, and helps concentrate. The right use of yellow can inspire enthusiasm, while green provides balance and serenity. Likewise in children, each color can cause certain emotions. Feelings of happiness arise when viewing warm and soft color stimuli such as pink and purple, and enthusiasm increases with yellow color. Meanwhile, the majority of shades of gray are connoted with sadness and black with anger said Boyatzis in [17]. The same thing was stated by Hill in [18] majority of students mentioned pink, purple, and blue as the most preferred colors. Based on gender, male students prefer blue and green while girls prefer pink and purple. At preschool age, 66.67% children choose book because of the bright colors on the cover page. This relationship is also reciprocal. Pratiwi and Budisetyani said in [19] that positive and negative emotions that are being felt by children will affect the choice of dominant colors, bright or dark according to their feelings.

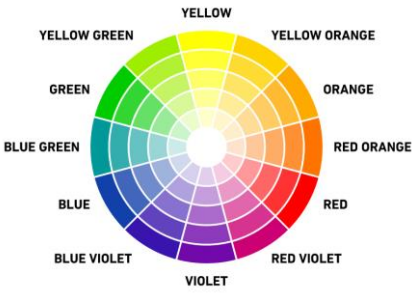

Figure 5 Color Scheme (Source: Google).

Color selection in animated learning video needs to be done properly. Although Aisyah said in [20] that the use of many colors in the learning process can increase children's creativity, but it should not be done excessively. The use of too many colors in one scene will spoil and make children not focus on the main elements of the story. Harmonization can be built by using analogous color that are side by side on the color-wheel such as green-blue and blue-purple in one scene, this will be more easily accepted by the eye and more memorable said Heinich in [21]. The use of a clean and non-dominant background color also makes it easier for children to focus on the main content. Generally, children like warm colors such as red, pink, yellow, orange, and also brighter color tones than adults said Heinich in [21].

3.3 Special-New Information

Delivering new things that are not yet known and inserting special things or unique facts will attract children's attention. For simple topics such as wearing shoes to train independence, it can be continued by exploring detailed stories such as the early history of shoe making, the country of origin, the materials used, the unique shape of the shoes, to the largest and smallest sizes ever, said YouTube Kids in [11]. Children will be happy to get information that is rarely known even by adults around him, because he can share new knowledge. Submission in the form of stories will increase children's interest said Fitrika and Khaidir in [22], so animated learning video must have a clear and interesting storyline to follow. The story method is also considered effective in developing children's language skills said Aris and Kusumaningrum in [23] and moral development said Putri in [24].

3.4 Positive Vibes and Emotions

A pleasant learning atmosphere will cause positive emotions in children which makes it easier for information to pass through the amygdala filter. Pleasant experiences will also encourage the production of the hormone dopamine in the body. Mansur said in [25] the best way to learn in early childhood is through games, children will get new experiences and expand their understanding through a variety of play activities with specific goals. According to Zosh et al in [26] playful learning means free-play, guided-play, or games which children have chance to explore or led the activities. Playing experience is an optimal way to build a child's understanding in depth, as well as being able to connect concept knowledge and abilities.

Lieberman research in [27] explained that playfulness was originally defined as the quality of play in a preschool classroom, which is a combination of the

fullness of the physical, social, and cognitive aspects of spontaneity, joy, and a sense of humor. The measuring instrument for the five dimensions is a questionnaire with a Likert scale of 1-5 points with 10 question items for the age range of children, and the addition of 2 items for adults. Dimensions of physical spontaneity are measured from the intensity of motoric movements and motoric coordination during the learning process. The dimension of social spontaneity is measured by the intensity of social interactions that occur between children verbally and the area of child mobility. Cognitive spontaneity is measured by the intensity of responses such as answering, critical thinking, asking questions, and the level of imagination during activities. Feelings of pleasure are measured by the intensity of the expression shown and the form of expression. And lastly, the sense of humor is seen from the intensity of the presence of an atmosphere of humor and its duration during the learning process. This measuring tool was later developed by Barnett in the form of the Children's Playfulness Scale (CPS) instrument consisting of 23 question items with a 5-point Likert scale. Bundy developed a Test of Playfulness (ToP) which consists of 29 4-point Likert scale questions that can be used to measure playfulness in the age range of 6 months to 18 years, mentioned by Snow in [28].

With Lieberman's approach, the fulfillment of playfulness in animated learning video can be judged by how much content invites children to actively move, such as singing, dancing, jumping, clapping, stomping, or act as walking through an area. Show social interactions between characters or invite the audience to see the people around them. Video content also invites critical thinking by asking questions and providing time lag for the audience to answer. Then invite children to take part in finding solutions through the characters in the video. That way, children will feel engaged and immersed in the story. In addition, the intensity of the scene that displays the expression of enthusiasm and happiness and humor during the animated learning video is also used as an assessment parameter. Then watching animated learning video will be a fun and memorable experience for children.

4 Science of Learning

A media needs to meet the educational aspect if it is to be referred to as a learning medium. The measurement of the "Science of Learning" aspect that has been popular since the 1990s includes active-engaged learning, meaningful learning, socially-interactive learning, and supporting the achievement of learning goals said Hirsh-Pasek in [29].

4.1 Active and Engaged Learning

Beside involving physical involvement, active learning also builds connections and mind involvement between children and the object. Adults can pretend to

discover something new by accident, with this way children will think that the adults around them do not teach everything that exists, so children will be motivated to explore on their own said Zosh In [26]. Hirsh-Pasek in [29] emphasizes the fulfillment refer to active brain activity to answer questions and understand the concepts described in digital applications. This aspect can be measured based on the intensity and form of the stimuli given to reach the stage of cognitive development of children according to their age. Symbolic thinking in preschooler is being able to recognize number symbols and count 1-10 and associate them with real objects can be triggered by displaying counted objects, number of symbols, and audio. Another indicator said Mansur in [25] like understanding concept of time can be introduced through visual stimuli of character interactions with surrounding objects, as well as exploratory activities carried out by characters. In the preschool segment, the priority is focused engagement said Hirsh-Pasek in [29], this is because children are often easily distracted by other, more interesting things. The level of children's engagement with animated learning video can be measured based on the attitude of the child who devotes full attention to the object, the child's attachment to the object or character in it, such as not getting bored watching repeatedly.

4.2 Meaningful Learning

A good learning process must be able to strengthen knowledge that was previously owned by the child. According to Gunstone in [30] meaningful learning is considered as more valuable learning and can be applied in real life contexts. Sharan said in [31] that constructivism and cooperative learning theories show a shift in understanding from learning as a mere transfer of information, becoming learning as processes and experiences. The ability of children to understand and relate new information to their basic knowledge is an assimilation stage that must be passed in a human cognitive process. The next stage, accommodation and organizing information, will make children build complete concept. In animated learning video, meaningful learning aspects can be fulfilled by applying conceptual understanding into scenarios of everyday experiences. For example, a preschool child's logical thinking ability, like able to classify objects with the same shape or color can be raised in a treasure hunt story and each object must be stored in the right box. Numerical abilities can be directly applied by increasing or decreasing the number of characters in a scene, for example in the story there is one friend lost and children were asked to count all character personnel. With direct application method into story, children will practice relating science to real life. In addition, children will understand the benefits of learning so it will motivate children's enthusiasm for learning. Another method according to Zosh in [26] is dialogue by questioning that inspire children to think about possible future events and how the character feeling.

4.3 Socially-Interactive Learning

The involvement of children's social aspects in the learning process is needed to achieve effective learning. Zosh said in [26] strong relationships will be built when children learn to communicate ideas, hear and accept other people's thoughts and opinions, and work together. Children will observe and be able to imitate the behavior of their social partners, adults and peers. In social interaction there is physical coordination in the form of verbal and non-verbal, and awareness of the people or events around them stated by Sharp in [32]. However, not only having social partners, the social interactions must be high quality, cooperative, and collaborative according to Hirsh-Pasek in [29], not breaking the child's concentration. According to Mansur in [25] forms of support that can be given by adults for children's social development include providing opportunities for children to play with their friends and provide lessons on how to be kind to friends. Digital media interactivity can be measured using Shedroff theory based on:

1. **Control**, how much user involvement, what controls/actions can be provided by the user;
2. **Feedback**, how responsive the object/interface responds to the actions given by the user
3. **Creative Experience**, allows users to create or share their activities according to their own wishes. This is important to provide a more engaging, meaningful, and rewarding experience.
4. **Productivity**, the existence of making / determining activities carried out by users
5. **Communication experience**, communication features are available with fellow users
6. **Adaptive Experience,** there are options to change the behavior of objects, for example, user-level choices result in adjustments from the side of the object's interface display (action, environment).

Animated video cannot provide real-time feedback and adaptive experiences to the audience as in the use of apps. However, the scene of characters asking questions, pausing and appreciating is as if they are building the experience of getting feedback from children. Aspects of creative experience, productivity, and communication can still be established between children and the characters in the video, as well as between children and the involvement of adults who accompany them while watching.

4.4 Support Learning Goals

Learning process and media must be appropriate and support the achievement of learning objectives. The cognitive development achievements of preschool

children are divided into the dimensions of problem solving, logical thinking, and symbolic thinking. Animated learning video should focuses on one to two indicators to be achieved, specific, and deep, so that children can understand completely. For example, the introduction to size of some objects can be followed by sorting objects according to size. According to guidance from YouTube Kids in [11], the preparation of the learning video flow can be started by exploring the purpose of making, the main goals could be broken back into several parts, and ending with how to achieve these goals through proper video animation.

5 Result: Instrument of Measure Effectiveness

An instrument for measuring the effectiveness of animated learning video has been compiled through the overview of RAD learning, Lieberman's playfulness, and Science of learning theories. This tool divided into three aspects with totally 19 (nineteen) items. With this instrument, an educational animation is evaluated based on aspects of appearance, content delivered, and the atmosphere in it. It summarized in the following table:

Table 1 Instrument of Measure the Effectiveness of Animated Learning Video for Preschooler.

Aspect	Indicator(s)	Item(s)	Practice(s)
Appearance	Unique-surprise	Audio stimuli	Backsound intro
			Song
			Slogan
			Voice of character
			Sound-effect
			Mnemonic
			Diction
		Visual stimuli	Character's silhouette
			Character's personality
			Attribute(s)
			Illustration
	Color selection	Interest	Based on age
			Based on gender
		Harmonization	Analogous color
			Clean background
			Clear font
		Emotion-effect	Positive impact
	Active-engaged	Minds-on	Response/feedback
			Question
			Explore
			Creative
		Immerse	Attention and focus
			Physical spontaneous

			Attachment to object/characters/content
Content	Support learning goals	Purpose	Specific
		How to achieve	Story board
			Problem to solve
	Special-new information	Details	Historical fun-fact
		Wide	Put in some context
	Meaningful	Process	Experience
		Assimilation	Relate with current knowledge
			Applicable
		Accommodation	Understanding concept
Vibes	Playful	Activity	Free-play
			Guided-play
			Games
		Joy/excitement	Face-expression
			Gesture
		Humor	Verbal
			Non-verbal
	Social-interaction	Cooperative	Physical coordination
			Communicate ideas
			Accept others opinion
		Collaborative	Work together

In the aspect of appearance, the first achievement indicator used is the presence of elements of uniqueness and surprise as well as indicators of choosing the right color so that it becomes attractive for children. It is based on the theory of RAD learning that in order to pass the first filter of the Reticular Activating System brain, a new piece of information must be interesting enough. The unique and surprise indicator is measured by aspects of audio and visual stimuli. Audio stimuli in an animation are very important to be placed in the intro to attract attention at the beginning. It can be in the form of a backsound as in "cocomelon", songs such as in "upin & ipin", or a character's voice such as in "pinkfong" and "nussa rara". Audio appeal also needs to be consistently placed in several scenes throughout the animation, it can be sound effects as hyperbole of certain moments, the use of mnemonics and rhymes so that they are more familiar and memorable for children, or even introducing new words with the use of appropriate diction. Meanwhile, visual stimuli are presented in animation in the form of a unique character display that represents their personality. This visual display should have a deep and special characteristic so that the audience will immediately recognize the character when it is present anywhere, such as "upin & ipin" with a bald head and consistent color of clothes, or the stitch character in "lilo and stitch", as well as attributes and illustrations that support verbal explanation. The color selection indicator is measured based on item interest, harmonization, and emotion-effect. In general, children will like certain colors based on their age range and gender. The application of color harmonization will be more acceptable to the eye, but still pay attention to the emotional effects based

on color psychology. The active-engage indicator is based on the theory of Science of Learning, Lieberman, and Shedroff. Consists of two measurement items, namely minds-on and immerse. Minds-on is said to be fulfilled if the appearance triggers a response from children like comments, answers, or questions. Children also show exploratory and creative behaviors such as developing new stories based on the animations they see, or associating certain objects with other meanings. While the immersion aspect is represented by an attitude of focus and attention to educational animation showed, giving physical spontaneous such as following the movements of the characters in the story like raising their hands, looking, or jumping, as well as attachment to the characters in the story.

The content aspect consists of three indicators, namely support learning goals, give special-new information, and meaningful learning. An animation is said to support learning goals when it has specific goals in each video, a clear story board, and presents problems and invites the audience to find solutions together. Special-new information conveyed can be in details history of an object or location, fun facts, and expansion of the explanation by putting in some context. This information will make the child feel that he knows something that others do not necessarily know, so he will eagerly share that information with others. The last item, namely meaningful learning occurs when children experience the learning process, following actively. The content in the video also directs the assimilation process by relating knowledge to its application in everyday life. That way there will be a process of accommodation where the child can understand the whole concept.

The last aspect to be measured is vibes, which consists of two indicators namely playful and social-interaction. Playful indicators include measuring items such as activity, excitement or joy, and humor. Fun activities for children in the form of free-play, guided-play, or games, where children are not fully dictated or regulated by adults, but are given space to determine, explore, and express. The joy item can be seen from the child's facial expressions and body gestures while watching, the presence of verbal and non-verbal humor. While indicators of social interaction are measured by two things, namely cooperation and collaborative. It can be physical coordination such as giving signs, or adding different ideas between characters in the story. Collaborative items are indicated by the cooperation between characters. These will give children an example of how to build good social interactions with the surrounding environment.

6 Conclusion

The study was conducted to develop an instrument for measuring the effectiveness of using animated learning video for preschooler. This is motivated by a shift in the trend of conventional learning to digital learning today. Meanwhile, at preschool age during the golden age, children need maximum stimuli to support their development. The process in this study includes the collection and comparison of theories related to elements in animation, the development of preschool-aged children, and the learning process and effective learning methods for preschooler. The main theories used as the basis for the preparation of the instrument are RAD learning, Lieberman's playfulness, and science of learning. The sources used are books, journals, theses, whitepapers, statistical data, and questionnaires. Based on the analysis, an instrument for measuring the effectiveness of animated learning video is formulated which consists of three aspects (appearance, content, and vibes) with a total of nineteen items. In addition to further development, it is necessary to validate the research results through the use of this instrument as a measuring tool for several existing preschool children's animated learning video.

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