

Forest Multiplication: A Game Based Learning Apps to Enhance Learning Experience in Multiplications for Primary Students towards 21st Century Learning Skills

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Abstract: Nelson Mandela once said, education is a powerful weapon to change the world. The power of education extends beyond the development of skills that we need for economic growth. By having numbers of scientists, engineers, technologist, doctors and other professionals it will helps the nation to prosper. Thus, early education in science, techonology, engineering and mathematics are important and is the answers for a better nation in the future. Mathematical subjects are important subjects in producing a competitive generation in the science and technology fields. From interviews, questionnaires and observation, most of primary school students have difficulties and lost motivation on learning mathematics especially for multiplication operations. Thus, the objective of this study is to investigate the problems on learning mathematics for primary school students and propose a solutions to enhance their learning experience in mathematics. In order to achieve the objectives, a study was made from respondents of Sekolah Kebangsaan Taman Universiti, Mersing National School and Sekolah Kebangsaan Bukit Badong. ADDIE model is the methodology that have been used to develop the solution which is a game based learning applications. Finally, this project has a big potential to be commercialised.

Keywords: Learning Experience, 21st Century Learning Skills, Game Based Learning. Learning Mathematics

1. Introduction

Forest Multiplication is a game based learning application that is developed to enhance learning experience in mathematics that focus on multiplication for primary school students. As mention before, students have difficulty in understanding and solving problems related to multiplication during primary

school. The development of this application is an effort to achieve the 21st century learning styles [1] and in line with the National Technology Advancement agenda [2].

By having Forest Multiplication Game Based Learning Apps it is an additional learning method to assist students. Learning methods are the process of acquiring knowledge from various sources for example from educators [3]. Through questionnaires, traditional learning methods is the factors that need to be enhanced with the current trend of technology.

New instructional design will also need to be proposed. Thus, the Forest Multiplication Game Based Learning Apps provides three learning methods which are the multiplication song method, lattice method and common form method. The multiplication song method is the method of understanding the multiplication in mathematics by using the song because it can create a beautiful learning environment and act as a baking spirit and passion to learn [4]. While lattice method is considered the best way to help students solve mathematical problems associated with big digit numbers [5]. This method uses a partition that each one is divided into two parts by a line [6]. Finally, common method is a commonly used method for students to solve the multiplication problems.

2. Materials and Methods

The literature study is the finding of previous studies similar to the title of the study being studied as reference material [7]. Previous findings are found to strengthen the matters discussed in the study.

2.1 Observations on Difficulties of Learning Mathematics

Despite always being taken for granted and lack of motivation to learn, Mathematical subjects is an important subjects to understand and a must passed subject for students. There are several factors that contribute towards problem in mathematical learning.

The main factor was due to the perception of students who thought that mathematical subjects were a difficult and tedious subjects. It had raised a sense of interest to pursue mathematics. The multiplication operation is one of the basic mathematical operations that are difficult to learn by most students.

Besides that, there are many formulas that need to be memorized, which resulting in students having difficulties and fear in trying to solve mathematical questions [8]. This is because some students are unable to memorize all the formulas in mathematics causing them not be able to answer the mathematical question, especially during the examination. On top of that, most of the teachers in school are still using traditional teaching methods and techniques [9]. The techniques has resulted in students using only full listening skills from teachers during the learning process.

In conclusion, these factors have resulted in poor achievement of students in mathematics and far away from the predetermined target [10]. So, these issues need to be solved for education standards of Malaysia to achieve new and greater heights.

2.2 Teaching Methods

Teaching methods are the means of a thing to be delivered. There are two methods of teaching that have been identified, which are traditional methods and game-based learning methods.

The traditional method is the way of teaching that only uses textbooks as subjects and only occurs in the class only. While game-based learning method is a method that uses graphics, videos and audio as a student's help material using electronic devices such as mobile phones [11].

In conclusion, traditional methods is still dominant in school. In line with the current progress, the game-based learning methods has been introduced to enhance the understanding of which this method is visually decorated that can provide an approach to these modern-day students.

2.3 21st Century Learning

The 21st century learning was a new transformation that was implemented to replace the traditional education. In the 21st century learning it is vital for a student to master the skills of the industrial revolution 4.0. There are several studies stating that game-based learning can be made as a method to master the skills of the 21st century [12] find that the game based learning methods can have a positive impact on the users where it can increase confidence in solving problems. The video game is among one example of a game method that can train users to solve the problem according to the difficulty level found in the game. In conclusion, game-based learning is one of the crucial roles in achieving the production of the 21st century learning environment.

2.4 Critical Success Factors for Game Based Learning Application

The production of Forest Multiplication Game Based Learning Apps emphasize on various aspects such as color, audio and instructional design of application flow. The color is a wave that can be sampled by humans [13]. Color is very important in life where the color will turn the environment of human life. Some of the colors used to enrich the Forest Multiplication Game Based Learning Apps are green, yellow, white, blue, purple, orange and red.

Each color used has distinctive effects such as green color is a color that gives peace to individuals, yellow colors is to helping children to enhance the spirit and self-motivation of [14]. In addition, white color can increase the level of IQ intelligence to more complex levels [15]. The blue color will be able to provide peace and improve the positive mind level. Next, Purple's color can impact the creative thinking of the user [16] orange color is categorized as a bright color that helps to inspire the mood of happiness as well as the children will have high confidence. Finally, the red color can give you a passion and courage and it is suitable to be seen by consumers when using the Forest Multiplication Game Based Learning Apps while facing challenges of difficult questions.

The next factor is audio. Music is a sound that is produced and good to hear [17]. It is therefore suitable to be introduced to children as there is a lot of good impact on the use of music in learning especially for children, which can produce cognitive-skilled children where children can think of themselves extensively. This application chooses the background of the music environment which is forest based on the concept of the forest-themed app. This is because the concept of providing peace to the user without giving pressure on playing the Forest Multiplication Game Based Learning Apps app. In addition, each writing in the application comes with an audio and it makes it easier for students who is known to have problem in spelling to know the letters and to understand the direction. Next, the use of the song as a learning method is provided in this application because it is believed that learning through listening skills can help increase understanding and speed in receiving information. Thus, through the song, singing can help the brain to boost memories and quickly remember the information [18].

The last factor is the instructional design of application flow especially the movement control button. The use of buttons in the Forest Multiplication Game Based Learning Apps is systematically organized to have a positive impact on the user. This application uses video games where this game requires players to jump to other platforms and requires buttons to move the character. Therefore, in this application, button to move the character to the left and to the right is stacked on the left of the application while the jump button is stacked on the right side of the application. This is because there are studies that shows the correlation of the use of hands with the brain. The advantage of using the left hand activates the use of senior brain where the senior brain controls activities such as writing, language,

scientific skills, mathematics, logic and list. In addition, the left brain is to control emotion, art, create creativity, space consciousness, imagination, dimension and signal [19].

In conclusion, these factors have been playing a role to produce attractive and effective applications to consumers. Color indeed plays an important role in education where it is able to enhance the spirit of learning, making a fun learning environment to attract students to learn because of its attractive colors. Audio as well can also create a fun atmosphere, with interesting audios while a systematic button arrangement can produce creative players because using both hands can make use both sides of the brain.

2.5 Studies on other Mathematic Learning Applications

Observations and research have been done on some applications related to mathematics with multiplication topics. Among the applications that are compared are shown in Table 1:

Table 1: Comperative Studies On Mathematics Learning Application

Item	Free Multiplication Tables Games	Icon
1	Free Multiplication Tables Games	
2	Times Tables & Friends	
3	Multiplication Game	

These three applications are compared to knowing the advantages and disadvantages between applications. Table 2 shows the differences between these applications.

Table 2: Comperative Studies on Elements of Mathematics Learning Application

Item	Free Multiplication Tables Games	Times Tables & Friends	Multiplication Game
Background Audio	No	Yes	No
Instruction	No	No	No
Method of Learning	VAK	VAK	VAK
Level of Difficulties	No	Yes	No

In conclusion, each application has been developed with its own effects. Therefore, through the comparisons that have been done, all deficiencies in the existing application will be improved in the Forest Multiplication Game Based Learning Apps to differentiate it from the applications that are already available on Google Play as well as help users to improve skills in the multiplication basis.

2.6 The effectiveness using Gamed Based Learning

In order to enhance the teaching method, besides traditional teaching, application development is a suitable method to use. The use of applications is the use of teaching using technology which is believed to have an impact and advantage of learning development if combined with conventional method [20].

The benefits in developing a game-based learning application is to be able to create a fun atmosphere while learning. In addition, users can provide full focus on education and to enhance the

ability and skills of children in mathematics. In this regard, user mindset became more complex and more forward in solving problems. In addition, it can provide an early approach to children who are not suitable for entering the school. This can give the children an early experience in mathematical learning. The next advantage is that students can change their mindset over the thoughts that math is a tough and difficult subject. This is because this app provides an interesting interface and can pose as an enjoyment and happiness while studying. Finally, students can improve the understanding of mathematical learning by learning a variety of methods that can help strengthen their knowledge in mathematical subjects.

Despite this, there is a disadvantage in developing applications aimed at learning. Among them is that each user requires the security of a mobile device to access the application. In addition, prolonged use of the app can cause a physical strain effect especially on children because too focus looking at at the screen of a mobile device while using the application [21]. Long-term consumption can result in neck pain, back pain, and especially eye pain. Therefore, a very objectionable game, excessive use can also cause social isolation.

In conclusion, a game-based learning concept application brings a lot of benefits from creating a lot of cons. Therefore, this application is suitable for the use of student atan early age.

3. Methodology

The implementation of the planned Forest Multiplication Game Based Learning Apps development is based on the ADDIE model. The ADDIE model consists of Analysis, Design, Development, Implementation and Evaluation as per shown in Figure 1.



Figure 1: The ADDIE Model

3.1 Analysis

In The analysis phase, we refers to various papers where there are studies that have been done to identify the problem. Studies have been done in some articles stating that a difficult mathematical operation of mathematics is multiplication. The multiplication topics in mathematics were problems among students and were difficult to learn [22].

3.2 Design

The design phase is when the storyboard began to be carried out after the data has been collected in the analysis phase. Selection of ways to solve problem statements is discussed and found the game-based learning application suitable for development and use for kids learn basic mathematical multiplication. This phase tells the overall design and interior filling of the application and some of the sample design is being shown in Figure 2 and Figure 3.

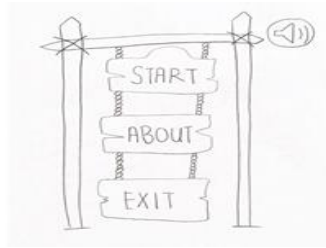


Figure 2: Main Menu

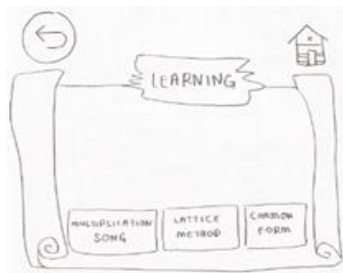


Figure 3: “Learning” Menu

3.3 Development

The Development phase is a phase where we did research and made decisions in the use of the appropriate tools and materials to develop the application. The main software to be used is the unity Hub (64-bit) And Visual Studio 2019 where the unity Hub (64-bit) is used for those applications that are able include various elements that are important to form an application while Visual Studio 2019 is to establish elements found in the construction of the application through the coding process by using the C# language.

3.4 Implementation

In the implementation phase, completed applications need to be tested. So, the Forest Multiplication Game Based Learning Apps was tested by taking several users as respondent. Figure 4 and Figure 5 are samples of the developed applications interface.



Figure 4: Home Interface Menu



Figure 5: “Learning” Menu

3.5 Evaluation

The final phase is the assessment phase where the application will be evaluated by the respondent through questionnaire in Google Form. The implementation of this phase for us to figure out whether the application developed has achieved its targeted objectives.

4. Results and Discussion

There are various studies that have been carried out to achieve this Forest Multiplication Game Based Learning Apps development. These are through tests, closed and open questionnaires as well as references and research from websites, related articles and newspapers.

4.1 The result of the multiplication calculation test

As a result of the multiplication calculation test by 29 respondents from the standard fur students where 25 respondents are from Sekolah Kebangsaan Taman Universiti 3 while 4 respondents from different schools, which are 2 students from Sekolah Kebangsaan Mersing Kanan and the remaining two students from Sekolah Kebangsaan Bukit Badong. Table 3 shows the results of the multiplication calculation test.

Table 3: Results of The Multiplication Calculation Test

Marks	Number of Students
10-20	3
21-30	9
31-40	9
41-44	8

4.2 The result of the Questionnaires

In addition, there are two types of questionnaires that have been conducted which are pre development and post development questionnaire. The pre development questionnaire is being answered by the students from Sekolah Kebangsaan Taman Universiti 3. This questionnaire is very important in proving the validity of the problem statement. A total of 7 questions has been prepared for the respondent, and the respondent has provide an answer based on their own views. Table 4, shows the results of pre development questionnaire.

Table 4: Pre Development Questionnaire

Questions	Agree	Disagree
Are you satisfied with traditional learning methods in mathematics?	48	35
Do you agree, less attractive learning environment is a problem factor in learning Mathematics?	49	15
Do you agree, elusive learning methods are a problem factor in learning Mathematics?	52	5
Do you agree that the use of game-based learning applications can attract students' interest and enthusiasm in learning Mathematics?	54	3

Do you agree with the use of game-based learning applications (game-based learning) can make a learning more meaningful and effective?	54	5
Do you agree that the use of game-based learning applications can help students develop a better understanding of mathematical concepts and applications?	54	5
Do you agree to make game-based learning as a student aid?	54	5

Then, we have the post development questionnaire, to justify the acceptance of the Forest Multiplication Game Based Learning Apps. Table 5 shows a summary of the questionnaires. Both of these questionnaires were made through Google Form.

Table 5 : Post Development Questionnaire

Questions	Agree	Disagree
In your opinion, are you satisfied that the Forest Multiplication Game Based Learning Apps app can help preschool and year 1 children to learn multiplication?	8	0
Do you agree that the Forest Multiplication Game Based Learning Apps application attracts users' interest and enthusiasm in learning Mathematics?	8	0
Do you agree that the Forest Multiplication Game Based Learning Apps application helps improve user learning strategies and capabilities in solving multiplication problems?	8	0
Do you agree that the Forest Multiplication Game Based Learning Apps application can improve student learning performance?	8	0
Do you agree with the use of game-based learning applications (game-based learning) can make a learning more meaningful and effective?	8	0
Do you agree that the use of game-based learning applications can help students develop a better understanding of mathematical concepts and applications?	8	0
Do you agree that the Forest Multiplication Game Based Learning Apps application is suitable as a learning aid?	8	0

5. Conclusion

As a conclusion, the development of the Forest Multiplication Game Based Learning Apps Game Based Learning Apps can help to overcome the mathematical subject learning issues occurring among students and manage to enhance their learning experience. The use of the Forest Multiplication Game Based Learning Apps Game Based Learning Apps has increased the spirit of the user and has given a

fun learning environment compared to the use of traditional teaching methods. This could be proved by a 100% of respondents giving overwhelming feedback on the use of the Forest Multiplication Game Based Learning Apps application compared to 27% of the respondents who supported the environmental of an attractive traditional method. In addition, the effect of using the Forest Multiplication Game Based Learning Apps application can enhanced the understanding and skill of the user in multiplication because there are three teaching methods available in this application compared to a less obvious description of topics when using traditional methods. This study can be shown by a 100% of respondents who strongly agree to choose the use of the Forest Multiplication Game Based Learning Apps application as an effective learning material compared to the traditional method of 9.26% of the respondents supporting the effective teaching method as per shown in Figure 6. Overall, the Forest Multiplication Game Based Learning Apps application was able to solve the problems of basic multiplication among primary school students.

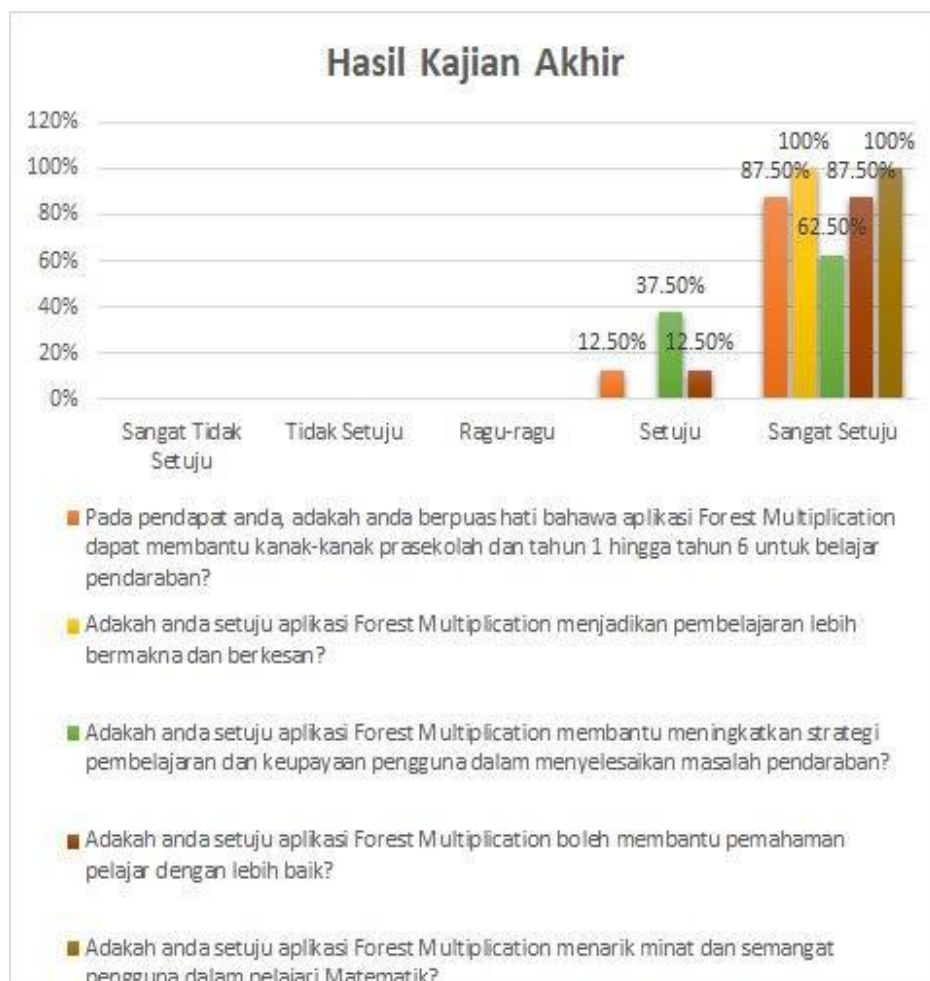


Figure 6: Conclusion graph

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References

- [1] Lah, F. C. (2018, Oktober 08). Pendidikan STEM. Retrieved from myMetro: <https://www.hmetro.com.my/bestari/2018/10/384491/pendidikan-stem>
- [2] Puteh, S. N. (1997). *Penulisan Ilmiah-Pengajaran Alaf Ke-21*. Retrieved from in SlideShare: <https://www.slideshare.net/safinahat/pembelajaran-abad-ke-21-76116330>
- [3] Nawi, D. H. (2011). *Pengajaran dan Pembelajaran*. Retrieved from Kongres Pengajaran dan PembelajaranUKM : <http://umkeprints.umk.edu.my/111/1/P%26P%20Penelitian%20semula%20menurut%20GIIM.pdf>
- [4] Salim, H. B. (2010, Oktober). Penggunaan Muzik Dalam Pembelajaran dan Pengajaran. *Kerja Amali Kemahiran Hidup Sekolah Rendah*, 14. Retrieved from <http://eprints.utm.my/id/eprint/29531/1/HamisanSalimMFP2010.pdf>
- [5] P.L.KU, S. J. (n.d.). *Perlaksanaan Dan Keberkesanan Kaedah Lattice Dalam Pengajaran Kemahiran Matematik: Satu Kajian Kes Di Sekolah Rendah*. Retrieved from Artikal: <https://publisher.uthm.edu.my/ojs/index.php/oj-tp/article/download/4816/2892/> - **Rujuk daripada artikal**
- [6] Rusdin, N. b. (2016). *slideshare.net*. Retrieved from Keberkesanan teknik pendaraban bentuk lazim tradisional, lattice dan sigai dalam penguasaan kemahiran mendarab dikalangan murid tahun 3: https://www.slideshare.net/norazlin_mohd_rusdin/keberkesanan-tiga-teknik-darab
- [7] Rosmawati. (2012, January 5). *Kajian Literatur*. Retrieved from Wordpress: <https://rosma212.wordpress.com/2012/01/05/kajian-literatur/>
- [8] Lah, F. C. (2017, Ogos 7). *Bantu Masyarakat Pintar Matematik*. Retrieved from myMetro: <https://www.hmetro.com.my/bestari/2017/08/251195/bantu-lahirkan-masyarakat-pintar-matematik>
- [9] Suid, H. B. (2004). Faktor-Faktor Kelemahan Pelajar Dalam Mata Pelajaran Matematik. *Universiti Teknologi Malaysia*, 23. Retrieved from http://www.fp.utm.my/epusatsumber/pdf/fail/ptkghdfwp2/p_2004_6304_52c109afbeb24a6b89c44b752d2482c1.pdf
- [10] Muda, W. H. (2017, March). *Faktor-Faktor Yang Mempengaruhi Pencapaian Pelajar Dalam Matematik Di FPTV UTHM*. Retrieved from ResearchGate: https://www.researchgate.net/publication/318307329_FAKTOR-FAKTOR_YANG_MEMPENGARUHI_PENCAPAIAN_PELAJAR_DALAM_MATEMATIK_DI_FPTV_UTHM
- [11] Azura Ishak, Z. K. (2009). Perbandingan Pengajaran Berasaskan Multimedia dan Tradisional. *Jurnal Teknologi Maklumat & Multimedia*, 89: <http://journalarticle.ukm.my/3510/1/1.pdf>
- [12] Wong Weng Siong, K. O. (2018, Disember 13). *myjms politeknik*. Retrieved from pembelajaran berasaskan permainan dalam pendidikan STEM dan penguasaan kemahiran abad ke-21: <http://myjms.moe.gov.my/index.php/PMJSSH/article/view/4678/1493>
- [13] Abdullah, P. F. (2018, Julai 02). *Warna Dan Psikologi*. Retrieved from MyHEALTH Kementerian Kesihatan: <http://www.myhealth.gov.my/warna-dan-psikologi/>

- [14] Sahib, S. Z. (2019, Julai 4). *Warna Mampu Rangsang Minda Anak*. Retrieved from myMetro: <https://www.hmetro.com.my/hati/2019/07/471855/warna-mampu-rangsang-minda-anak>
- [15] Balqis. (2011, April 05). *Warna Merangsang Kepintaran Pelajar*. Retrieved from Mari Belajar: <http://matematik4u.blogspot.com/2011/04/warna-merangsang-kepintaran-pelajar.html?m=1>
- [16] Amalina. (2018, August 1). *impiana*. Retrieved from Kata Pakar guna pilihan warna ni untuk membentuk susana lebih tenang dan bahagia dalam kediaman.
- [17] *educalingo*. (2020). Retrieved from Meaning of music: <https://educalingo.com/en/dic-ms/muzik>
- [18] Samsudin, M. A. (2018, May). *Kepentingan Muzik dan Nyanyian dalam Pendidikan Prasekolah*. Retrieved from ResearchGate: https://www.researchgate.net/publication/338293436_Kepentingan_Muzik_dan_Nyanyian_dalam_Pendidikan_Prasekolah
- [19] *club greenboc*. (2011, january 11). Retrieved from kidal ada kelebihanannya: <http://greenboc.blogspot.com/2011/01/kidal-ada-kelebihannya.html>
- [20] Aman, M. (n.d.). *eprint*. Retrieved from Penggunaan Game-Based Learning Bagi Meningkatkan Kemahiran Penyelesaian Masalah Kreatif Dalam Matematik: http://eprints.utm.my/id/eprint/61616/1/ShaharuddinMdSalleh2015_PembangunanBerasaskanPermainanBagiMeningkatkanKemahiranPenyelesaianMasalah.pdf
- [21] Adams. (2017, September 22). *itstillworks*. Retrieved from The Disadvantages of Using Games As a Learning Tool: <https://itstillworks.com/negative-effects-computers-children-1483.html>
- [22] Siti hajar, M. Y. (2017). *conference.ukm.my*. Retrieved from Penggunaan Kaedah Petak Bijak Dalam Mengatasi Masalah Mencari Hasil Darab Dan Bahagi: Satu Kajian Tindakan: <http://conference.ukm.my/sprin/index.php/sprin/sprin/paper/viewFile/17/9>