The Readiness of Prospective Mathematics Teachers in Utilizing Technology in The 21st Century Learning Process

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Abstract. The purpose of this study is to find out the readiness of prospective mathematics teachers in utilizing the technology during the 21st century learning process. Research use a qualitative approach with subjects of this study were students from Mathematics Education Study Program of universities in Semarang who were carrying out teaching practice programs in schools. It can be concluded from the results of the above research analysis that the readiness of prospective mathematics teachers to use technology in 21st century learning is included in good criteria. The readiness is seen from: the knowledge that has been obtained during learning process in college; the facilities and infrastructure at college are adequate for students to access technological developments; the planning in creating the lesson tailored to the material, objectives and characteristics of students in the class; there is support from schools; mathematics teacher candidates also have good perceptions related to the integrated technology in mathematics learning.

Keywords: Technological skill, Prospective mathematics teachers, Learning media

1 Introduction

In the 21st century learning , digital communication technology is a key factor. Learning and learning must focus on the use of emerging or existing technological innovations [1]. In teaching and learning process, there are three subjects that cannot be overlooked, namely: educators, learners and materials. Educators here can be teachers or lecturers. The scary challenge facing the education system is the lack of competent teachers that are proficient in literacy or information technology [2]. Information communication technology (ICT) expertise is the ability to use technological tools and networks to determine, access, manage, integrate and evaluate the information from various sources; this ability is known as Information literacy [3]. Information and communication technology in learning act as a liaison in the implementation of knowledge transfer without completely eliminating the initial model of learning that takes place face-to-face in the classroom [4]. Utilization of technology in the learning process is of course intended for all fields of science, including mathematics.

Mathematics which is more abstract is easier to learn if the abstract object is changed in a concrete form. Therefore, the need for tools in the use of technology in mathematics learning can be in the form of instructional media. One form of utilizing the technological

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sophistication is to create or utilize technology as a learning medium that is interesting and more fun for students [5]. It is important for students to learn mathematics by utilizing the technology to overcome their problems during the learning process and fulfill the needs of students in gaining new knowledge[6]. In the process of learning mathematics, there are various learning media that utilize technology, such as: educational games, mathematical videos, interactive media, mathematics applications, etc. Learning media, one of the aims of the use of multimedia in learning is to facilitate the communication and strengthen the delivery of information using various types of media used (text, sound, graphics, animation, and video) [7] . In the Government Regulation of National Education Number 16 of 2007 Concerning Academic Qualification Standards and Teacher Competencies, it is mentioned that the teachers' pedagogical competence consists of: 1) mastering students' characteristics from physical, moral, spiritual, social, cultural, emotional, and intellectual aspects, 2) mastering learning theory and principles of learning to educate, 3) develop 61 curricula related to subjects, 4) organize learning to educate, 5) utilize the information and communication technology for the benefit of learning, 6) facilitate the development of potential learners to actualize the various potentials they have, 7) communicate effectively, empathically and politely with students [8].Through technology-based learning, students can experience interesting learning process, increase their motivation, and succeed the higher levels of learning outcomes [9].

In order to face these challenges and demands, the prospective mathematics teacher should be prepared to be able to utilize the technology. The readiness of prospective teachers in utilizing technology is of course also related to the lecturing process of prospective students in their respective University institutions. The curriculum used is also related to the rapid development of technology. The implementation during the lecture is also using technology as a learning media. At the time of microteaching, did the students also use technology in the teaching practice process? How did teacher candidates prepare various learning tools and learning media that will be implemented during microteaching or when teaching practice in schools? This, of course, will have an impact on the mathematics learning process in the classroom.

There is a demand for a teacher who can master the technology in 21st century learning; thus, researchers want to know the readiness of prospective mathematics teachers in mastering technology in learning mathematics when doing teaching practices in schools. Therefore, the purpose of this study is to describe the readiness of prospective mathematics teachers to use the technology in the 21st century learning process during teaching practice in schools. From this research, the benefits obtained are (1) providing information and insights related to the readiness of prospective mathematics teachers to use technology in the learning process in the 21st century, (2) to be an evaluation for universities in mathematics education study programs to be able to develop lectures more optimally in creating or utilizing technology-assisted learning media according to the competencies required by users, and (3) to be an evaluation and information for schools on the importance of school support in the use of technology in the learning process.

2 Method

The research was conducted using a qualitative approach. The subjects of this study were students from the Mathematics Education Study Program from Universitys in Semarang who

carried out the practical teaching program at schools in Semarang. The sampling technique in this study is snowball sampling which is a method for identifying, selecting and taking samples in a network or chain of continuous relationships [10]. In the *snowball* sampling technique, the researchers ask for information from the first sample to get the next sample, and so on until all the researchers' sample needs can be met, namely obtaining samples sourced from 5 Universities in Semarang that have Mathematics Education Study Programs. Data sources obtained by researchers were primary data obtained directly from samples through questionnaires and interviews. The following are the indicators of the readiness of prospective teachers in utilizing technology in learning mathematics in this study: Competency in mastering technology during learning process in college, competence in designing learning that utilizes technology, support of teaching practice schools in the use of technology in learning and the perception associated with technology integrated mathematics learning .

The questionnaire sheet used by researchers was mixed. This means that it contains closed and open questions. Indicator 1 -3 used Guttman scale. It is a firm and consistent measure of the attitudes, opinions, perceptions of a person or group of people about a particular phenomenon that want to be found out using the yes-no option and is accompanied by an open question so free sample gives answers accordance with the questions. Meanwhile, indicator 4 the questionnaire uses a Likert scale with a scale of 1-4.

Data analysis techniques were obtained using triangulation. Triangulation is defined as a data collection technique that combines various data collection techniques and existing data sources [11]. Thus, the questionnaire and interview data are then compiled to obtain a conclusion from the readiness of prospective teachers in utilizing technology in learning mathematics.

3Results and Discussion

The results of the study began with the preparation of a questionnaire instrument regarding the readiness of prospective mathematics teachers who used technology in 21st century learning. The instrument was tested in advance to determine the validity and reliability. Here are the results of the analysis of reliability and validity of each indicator.

Indicator 1 : consists of 25 statements

Table 1. Validity of statement items of indicator 1

No.	R count	R table (N = 27, α = 5%)	Results	No.	R count	R table (N = 27, α = 5%)	Results
1	0.181	0.3809	Invalid	14	0.7997	0.3809	Valid
2	0.425		Valid	15	0.4627		Valid
3	0.4435		Valid	16	0.537		Valid
4	0.5693		Valid	17	0.5996		Valid
5	0.3707		Invalid	18	0.537		Valid
6	0.4012		Valid	19	0.4722		Valid
7	0.4724		Valid	20	0.556		Valid
8	0.5623		Valid	21	-0.181		Invalid
9	0.659		Valid	22	0.537		Valid
10	0.4015		Valid	23	0.4615		Valid
11	0.1031		Invalid	24	0.5255		Valid
12	0.5123		Valid	25	0.1368		Invalid
13	0.4605		Valid				

The reliability results of indicator 1 show that the calculation of reliability is 1 with very high criteria. Therefore, the results of the analysis above show that out of the 25 statements available, a total of 20 items were used. Statement items that were not used were no. 1, 5, 11, 21, and 25.

Indicator 2 : consists of 10 statements

Table 2 . The validity of statement items of indicator 2

No.	R count	R table (N = 27, α = 5%)	Results
1	0.4834	0.3809	Valid
2	0.5729		Valid
3	0.4076		Valid
4	0.4756		Valid
5	0.4695		Valid
6	0.491		Valid
7	0.5068		Valid
8	0.7575		Valid
9	0.4297		Valid
10	0.4427		Valid

The reliability results of indicator 2 show that the reliability calculation is 0.6004 with sufficient criteria. Thus, from the results of the analysis above, all the 10 statements were used.

Indicator 3 : consists of 9 statement items

Table 3 . The validity of statement items of indicator 3

No.	R count	R table (N = 27, α = 5%)	Results
1	0.4483	0.3809	Valid
2	0.5276		Valid
3	0.4393		Valid
4	-0.122		Invalid
5	0.8226		Valid
6	0.4137		Valid
7	0.584		Valid
8	0.3901		Valid
9	0.6361		Valid

The reliability results of indicator 3 show that the reliability calculation is 0.4469 with sufficient criteria. Thus, from the results of the analysis above, 8 item statements were used. The unused statement item was number 4.

Indicator 4 : consists of 40 statements.

Table 4 . The validity of statement items of indicator 4

No.	R count	R table (N = 27, α = 5%)	Results	No.	R count	R table (N = 27, α = 5%)	Results
1	0.462	0.3809	Valid	21	0.699	0.3809	Valid
2	0.553		Valid	22	0.433		Valid
3	0.405		Valid	23	0.37		Invalid
4	0.494		Valid	24	0.68		Valid
5	0.373		Invalid	25	0.577		Valid
6	0.349		Invalid	26	0.411		Valid
7	0.506		Valid	27	0.449		Valid
8	0.413		Valid	28	0.444		Valid

9	0.626	Valid	29	0.131	Invalid
10	0.374	Invalid	30	0.491	Valid
11	0.276	Invalid	31	0.615	Valid
12	0.309	Invalid	32	0.358	Invalid
13	0.518	Valid	33	0.607	Valid
14	0.644	Valid	34	0.605	Valid
15	0.385	Valid	35	0.069	Invalid
16	0.494	Valid	36	0.42	Valid
17	0.691	Valid	37	0.318	Invalid
18	0.148	Invalid	38	0.366	Invalid
19	0.482	Valid	39	0.237	Invalid
20	0.333	Invalid	40	-0.209	Invalid

The reliability results of indicator 4 show that the reliability calculation is 1 with very high criteria. Thus, from the results of the analysis above, 25 statements were used.

The valid instrument was then tested on the samples. It obtained the results in indicator 1, namely the competence of technological mastery during college. This indicator was broken down into 4 sub-indicators, namely (1) the ability of lecturers to utilize technology in lectures, (2) the ability of students to use technology in completing lecturer assignments during lectures, (3) the availability of technological facilities and infrastructure that supports lectures, (4) The ability of students to use social networks for knowledge discussion. The following were the results of data analysis.

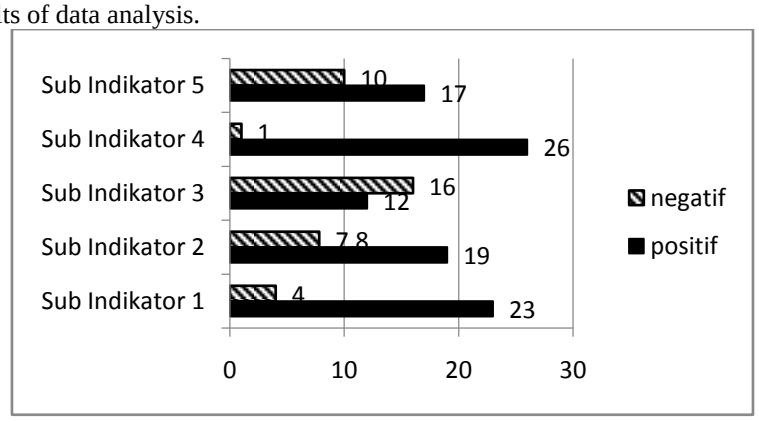

Fig.1. The competence of technology mastery during lectures

The Figure 1. shows that the average student candidates for mathematics teacher have the ability in mastering the technology during lectures in good criteria. This can be seen in the University of each student where over 96% of lecturers gave a lecture using technology in the learning process, at least the lecturers used power point. In addition, there were lecturers who used learning videos and software that supported the learning. Moreover, the curriculum of mathematics education study programs at each university provided courses that required the students to create the products in the form of learning media, both physical learning media (teaching aids) and audio video learning media. These subjects such as: Mathematics Teaching Aids Workshop, Multimedia Learning Mathematics, Learning Technology Applications, Development of Learning Media were named depending on the policies of each University. However, the products created in the course have not been implemented in the classroom when the students carry out the teaching practices in schools. There needs to be a match between the products produced with the materials when students carry out teaching

practices. The other thing is the willingness to support the technology infrastructure in the University, such as: (1) The computer labs are equipped with a computer, sound system, projector / LED monitors, software that support the lectures and adequate rooms; (2) teaching aids room equipped with equipment and materials to produce mathematical teaching aids, (3) lecture rooms are facilitated with projector / LED monitors in each class and adequate lighting. Another thing that supports is the ability of students in social media. In this digital age, of course all students have social media. Even though the use of social media is mostly personal, discussions about lectures often use existing groups on social media. New information is also obtained through social media.

The support of technology utilization from universities through courses, competent lecturers, and facilities and infrastructure that support lectures certainly become a factor that supports students in mastering technology. Arafah [12] states that academic infrastructure has a positive effect on students ' mastery. Besides, the quality of lecturers also influences students' abilities. With the existence of lectures that demand the mastery of technology in producing learning media, it certainly contributes to the readiness of prospective mathematics teachers in utilizing technology. Furthermore, whether students implement the knowledge gained during college or not, this study also analyzed the readiness of prospective mathematics teachers when implementing teaching practices in schools . The following is analysis of indicator 2 regarding the ability of prospective mathematics teachers in designing learning that utilizes technology. The picture below is the result of the ability of prospective teachers to design learning that utilizes technology.

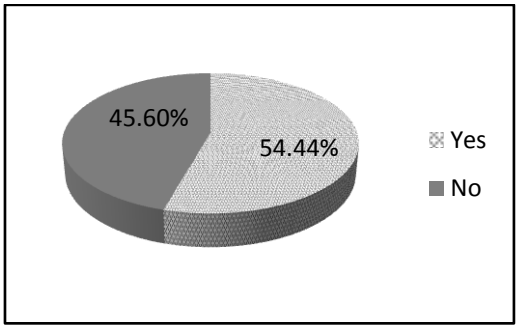

Fig. 2 . Competence in designing learning that utilizes technology

The Figure 2. show how that on average there are half of students who have designed learning by utilizing technology when carrying out teaching practices . The technology used was in the form of learning media . The majority of media used was in the form of PowerPoints and videos that are already on YouTube. The video used was more directed at motivational videos outside of learning material such as motivation for the need of teamwork, the importance of hard work through life, and a sense of tolerance in friendship. This certainly does not contribute to the maximum in learning. There were also prospective teachers who created a pleasant learning atmosphere through *talking stick* learning strategies combined with music, so students enthusiastically competed in learning. The existence of audio-visual learning media provides benefits for students in providing a different learning atmosphere. There is a difference in motivation and learning outcomes between learning using audio visual media and not [13]. However, there were also prospective mathematics teachers who designed the learning media by using technology other than PowerPoints, including the use applications that were already available, namely: kahoot and quizizz to evaluate learning.

Utilization of this technology was previously planned in advance through discussions with the supervising teacher and supervising lecture. The selection of instructional media that utilizes the technology was adapted to the learning objectives and material. Then, it was collaborated with interesting learning models or learning strategies. Therefore, the result of open observation showed the enthusiasm of the students in learning mathematics that used quizizz and the kahoot. The following are images of prospective mathematics teachers in utilizing technology when carrying out the teaching practices at school.

Fig. 3a. The use of quizizz

Fig. 3b. The use of Power Point

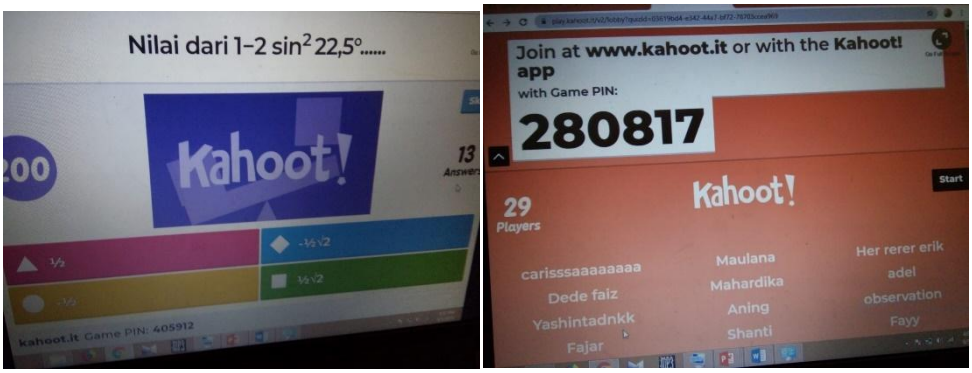

Fig. 3c. Learning evaluation design using Kahoot.

The Figure 3a. shows the process of learning mathematics by prospective teachers who utilize technology in the form of Quizizz applications. The Figure 3c shows the appearance of Kahoot on PC and android phones when designing learning evaluations. Utilization of quizizz and kahoot gives its own impression for students. It is because the mathematics teacher who has been teaching has never implemented quizizz and kahoot in mathematics learning. Thus, the students felt attracted by the use of technology in the form of quizizz and kahoot. The Fig.3b. shows the appearance of Kahoot on PC and android phones when designing learning evaluations (PPT). Teacher planning in learning process that utilizes technology, applying good learning strategies and creating enjoyable learning situations for students can make a positive contribution in improving the learning performance and increasing the student motivation in learning [14].Furthermore, the use of technology in the learning process will give an important contribution for students in obtaining a variety of new knowledge or information than can improve their skills and cognitive [15].

Planning compiled by prospective mathematics teacher in the use of technology in learning cannot be utilized if there is a lack of support from the school regarding the infrastructure technology in learning process. School rules in the use of technology also has significant role, where there are some schools that prohibit students from using mobile phones during the learning process. However, the results of direct interviews with school principals, the use of technology in learning is very supported as long as it does not interfere with the learning process. Therefore, if necessary, the students are allowed to use mobile phones for the learning process. However, there are indeed schools that give students freedom to use mobile phones with notes that, during the class time, it is used to support the learning process, for example for looking for the references or learning resources. Related to this, the results of the questionnaire analysis on Indicator 3 regarding the support of teaching practices schools in the use of technology in learning are described as follows.

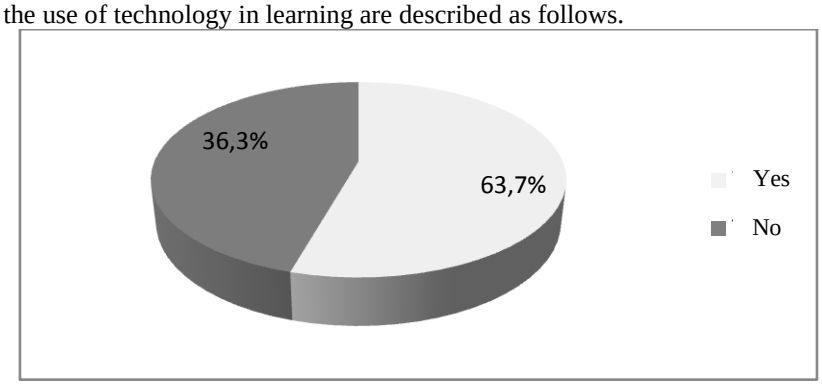

Fig. 4 . The support of teaching practices schools in the use of technology in learning

The Figure 4. show that all schools support the learning process that utilizes technology in the form of instructional media or it is limited to finding reference resources for students. Other supports in the form of facilities are the avalaibility of projectors in each class. Meanwhile, the sound system provided by schools is centered on facilities and infrastructure department; so if there are teachers who want to use it, they can borrow it on facilities and infrastructure department. The availability of technologies such as projector and computers in the classroom or school is very important in order to facilitate the teachers to improve the skills in utilizing the information technology and personal communication (ICT) as a medium of learning [16]. Support from schools in the use of technology in learning can also be used by prospective mathematics teachers during the teaching practice at school. Furthermore, it depends on the prospective teacher whether they can properly implement the capabilities they have in utilizing technology and the availability of technological facilities and infrastructure that supports mathematics learning.

The following is the analysis of indicator 4 on the perception associated with the technology integrated mathematics learning which is divided into 3 sub indicators, namely: (1) acquisition of new technology, (2) the ability to master classes, and (3) the ability of choosing the technology in accordance with the conditions of the class. The diagram below shows the perceived level of prospective mathematics teachers related to the technology integrated mathematics learning.

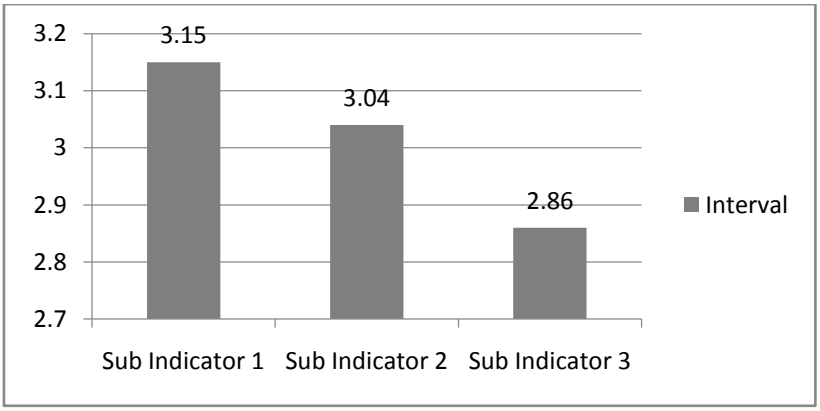

Fig. 5. the level of perception related to the technology integrated mathematics learning

The analysis of Figure 5. shows that the level of mastery of new technology possessed by prospective mathematics teachers is in the percentage index of 78.704%; so that it is included in the criteria of agreeing to join and utilize the new technologies, such as the existence of new applications on PCs, laptops or mobile phones that can used in learning mathematics. Prospective teachers are crucial in mastering recent technology to improve digital literacy [17]. The development of technology in learning in the 21st century requires all parties in the field of education to master the technology. One of them is teachers or prospective teachers who will substitute the senior teachers. If the prospective teachers are technology illiterate, Indonesia's future will lag behind other countries.Teachers' perceptions and attitudes about the use of IT-based media is one of the factors that influence the improvement of the quality of education in the context of IT development [18].

The analysis of mastery level of prospective teachers in the learning process in the classroom is in the index of 75.926% which is qualified as good in classroom management. It can be seen from the ability of prospective teachers in choosing a learning strategy, the selection of instructional media, various teaching styles adjusted to the learning objectives, and the student material and character. The teaching style of the teacher makes a significant contribution in the learning process [19]. The prospective teacher's learning style which is interesting and in accordance with learning in each class will make students feel motivated in learning so that it has an impact on the student learning outcomes. It is also supported by the ability to choose technology according to the class conditions. At present, the existence of technology creates the learning process which is no longer boring and difficult. This is because of the educational technology that has made the learning process more interesting and easy to use[20]. The results of the analysis of the ability to choose technology is suitable with the class conditionsobtained an index of 71.605% which is included in good criteria. The ability of prospective mathematics teachers in the mastery of technology and mathematics material provides sufficient contribution in creating the mathematics learning media that utilizes technology. The selection of media has also been adjusted to the material. The quality of the use of technology not only uses the technology itself but how the technology chosen can be integrated into the content of learning material [21]. The creating of the media is carried out by the teacher candidates when they are studying in a course which indeed demands a learning media product. However, when they carried out the teaching practice in schools, prospective teachers only used PowerPoint instead and some applications of learning that are already existed such as kahoot and quizizz. Learning media will certainly facilitate students in

learning mathematics in which there are limitations to the explanation of mathematics which is an abstract form. IT-based learning media create the multi-dimensional and multipurpose learning process [18].

4Conclusion

From results of the above research analysis, it can be concluded that the readiness of prospective mathematics teachers to use technology in 21st century learning is included in good criteria. Readiness is seen from (1) the knowledge that has been obtained during lectures in the university. All Mathematics Education study programs at every university have courses on technological development including creating learning media products that utilize technology; (2) Facilities and infrastructure at universities are adequate for students to access technological developments; (3) Planning in creating the lesson is tailored to the material, objectives and characteristics of students in the class, in addition to the discussion between teacher candidates and supervising teachers and supervising lecturers in the design of learning that utilizes technology; (4) There is support from schools in the use of technology in the learning process, one of which is the availability of projector in each class; (5) mathematics teacher candidates also have good perception on the technology integrated mathematics learning. However, during the implementation of teaching practices, the majority of instructional media used are limited to power points and videos from YouTube, while those who use existing applications are 20% of prospective teachers. This is because designing learning that uses technology such as making instructional media animation, interactive learning media or interesting learning videos takes a long time. Thus, with some administration that should be prepared before teaching, it is not possible for prospective teachers to create new learning media.

Suggestions from the results of the study include: (1) there needs to be a match between the media produced at the course that create products with the material used when prospective teachers practice teaching in schools, so the products created can be implemented; (2) Support from schools in learning that utilizes technology is very good, and it needs to be improved by providing sound system in each class.

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