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Description of the need for development of learning devices based on strengthening character education, literacy and 4cs skills in calculus i to shape 21st century prospective teachers

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Abstract
The purpose of this study is to describe the analysis of the need for development of learning devices based on strengthening character education, literacy and 4Cs skills in calculus I to shape 21st century prospective teachers. The approach of this research was descriptive research with a type of survey method. The sample in this study was selected by purposive sampling, totaling 335 second semester students from five universities, and twelve lecturers supporting calculus I from six universities, namely Unidha Malang, UMM, IKIP Budi Utomo Malang, Unikama, Unisma, and UIN Malang. Based on the analysis of student needs questionnaire data, it was concluded that approximately 75% of 335 respondents expressed strongly agree and agree when calculus I learning devices are developed based on strengthening character education, literacy and 4Cs skills. This was also reinforced by the opinion of lecturers, that 12 (100%) respondents strongly agreed if calculus I learning devices are developed based on strengthening character education, literacy and 4Cs skills, as a support for learning calculus I. So as to strengthen the values of student character, fostering culture reading, and increasing student literacy craze, as well as improving student skills are necessary in facing global challenges in the 21st century.

Keywords: development, learning devices, prospective teachers

1. Introduction

The issues of needs analysis in learning mathematics for university teaching developments become a prior concern in Indonesia The rapid development of this era forced the government to develop various aspects of education. The government through Permendik bud No 22 of 2016 states that the undertaken learning process must make students active, creative and innovative, so that it can provide meaningful learning experiences, and it is expected that students can find knowledge independently through previous experiences. Various attempts have been made by the government to improve the quality of education. One of which is to improve the quality of teachers or prospective teachers. As a teacher or prospective teachers must have a strategic role in the field of education, in order to be able to educate students with good quality. Also, teacher nowadays are concerned a lot on learner-centred pedagogy and creative mathematics learning approaches. (Adler, 2000) [1]

The existence of qualified and professional teachers or teacher candidates can be realized well if it is well prepared. One prospective teachers who must be well prepared is a Mathematics teacher candidate who is an LPTK student who is studying in a mathematics education study program. Here in after, a professional Mathematics teacher refers to a professional Mathematics graduated from Mathematics professional teacher education program. This is in accordance with Government Regulation No. 19 of 2017 concerning Amendments to Government Regulation No. 74 of 2008 concerning Teachers, that teachers are professional educators with the main task of educating, teaching, guiding, directing, training, evaluating, and evaluating students in the field of education.

As a professional Mathematics teacher, the ability to teach mathematics to students properly is a must because mathematics is given to all students to equip them with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to cooperate. Therefore it is very necessary to improve higher order thinking skills which is one of the priorities in Mathematics learning (PermenRI No 22 of 2006 [29] (Content Standard)).

Professional Mathematics teachers must have professional abilities regarding mathematical knowledge, attitudes, and Mathematics teaching skills. This is in accordance with UU RI No. 14 of 2005, concerning Teachers and Lecturers which states that as professional teachers must have several competencies, namely educational competence, professional competence, personality competence, and social competence. One ability that must be mastered is professional ability, which is the ability to master mathematical material widely and deeply. In line with this facts, Bobis *et al*. (2019) [7] summarized some examples from Assor (2012) [4] for professional mathematic teaching concepts today that is to enable the students to not only understand about conceptual mathematics, but also in being autonomous students who can handle tough problems. To this, as a student (prospective teachers) Mathematics must take Mathematics courses well. One of the courses that must be taken, namely the course calculus I. The course calculus I is part of the Mathematics that underlies other higher Mathematics courses. In general, the material for calculus I must be understood material functions, limits, and derivatives of functions, and derivative applications which are generally called mathematical analysis (Latorre, *et al*. 2007).

LPTK as the education provider of prospective Mathematics teachers, must be able to learn and prepare these teacher candidates well. Through professional teacher guidance, students can become human resources with good quality, be able to compete, and be productive as national nations so they can face global challenges and competition in the 21st century. The challenges of the 21st century include students (prospective teachers) Mathematics must master teacher competencies in accordance with UU RI No. 14 of 2005, namely educational competencies, professional competencies, personality competencies, and social competencies. The teachers also must master learning and innovation Skills (4Cs), including mastering the development of ICT, skills of 4Cs. The 4Cs skills referred to include (1) Critical Thinking, (2) Communication, (3) Collaboration and (4) Creativity (Trilling and Fadel, 2009; As'ari, 2016) [3]. These four skills are very important for prospective mathematics teacher students to become professional Mathematics teachers. Therefore LPTK must be able to instill teacher competencies as well as 4Cs skills in prospective teacher students in order to participate in global competition of the 21st century.

In addition, the formation of prospective teacher or professional teacher's character aims to have a tough soul, never give up, being competitive, have good attitudes and moral, have tolerance, be cooperative, work hard, understand science and technology, and have faith and devotion to God Almighty based on Pancasila (Gunawan, 2012). In fact, Soetanto (2012) [31] revealed that one of the strategies used in the application of character education, namely through learning strategies that can be done in every course in science and technology. However, science education should be followed by character education to overcome various social problems. According to Berkowitz and Bier (2005) [6] and Murphy (1998) [26], character education is a proactive effort made by educational institutions (universities) and the government to instill ethical values such as caring, honesty, fairness, responsibility, and respect for self and others (Character Education Partnership). Character education aims to improve the quality of the educational process and outcomes that lead to character education and noble morals of students in fully integrated manner. Likewise, through character education, students are expected to be able to independently improve, use knowledge, study, and internalize, and personalize character values and noble morals so that they are manifested in daily behavior (Mulyasa, 2013) [25].

The proficient teachers must have the ability to think critically in solving problems and to think creatively and innovatively at work. This is in line with the statement of Suyanto (2012) [35], that professional teachers are teachers who are always changing from old practices, even willing and able to leave the methods and models of learning used in the past to face the challenges of the present and the future. Another ability needed by a teacher (prospective teacher) of the 21st century is to have digital literacy capabilities. Digital literacy is the ability to understand and master digital technology, such as knowing a lot of information, mastering various kinds of digital media and mastering ICT (Kemendikbud, 2017) [19]. With digital literacy, if teachers or prospective teachers can master information and communication technology literacy, it will be better than just having technology skills (Partnership for 21st Century Skills, 2009). There are several abilities that need to be understood related to digital literacy, including: (1) digital scientific literacy, understanding theory and science, including the use of science and Mathematics using digital technology; (2) information literacy, the ability to find and utilize information from various digital sources and references; (3) digital functional literacy, the ability to understand and convey thoughts through a variety of media, including the use of images, videos, graphics, charts or visual literacy; (4) technology literacy, a component in the use of technology, especially technology that helps work as a productive teacher; (5) cultural literacy, the ability to understand and adapt to diverse cultures through access to digital technology (Koswara, 2018). As a results, digital technology can bridge teachers, students and other educating communities without the time and place limits.

Mathematics is one of the subjects that requires students to be actively creative and innovative in using formulas to solve mathematical problems correctly. Therefore, it is necessary to prepare learning tools properly. Learning devices are a set of tools that must be prepared and used by educators in the learning process (Suhadi, 2007) [33]. The better the preparation of learning devices developed, the better the implementation of the learning process will be. This is done so that students are able to learn well, so they can easily achieve the expected competencies. Therefore, the use of well-prepared learning media is essential in assisting students to learn Mathematics simultaneously.

Special universities, LPTK, is the leader of the progress of national education in Indonesia, so the 21st century skills needed by students must be integrated in learning activities at universities through LPTK. So that learning in LPTK can achieve 21st century skills, contain strengthening character education, as well as achieve literacy skills in students. It is necessary to develop good learning devices to support 21st century education concepts which include 4Cs skills, including (1) Critical Thinking, (2) Communication, (3) Collaboration and (4) Creativity. Learning devices must contain strengthening character education because it can change patterns of thinking, acting and behaving better in religioun, nationalist, independent, mutual cooperation, and integrity are the main values embedded in the national education system, including in the LPTK (Mulyasa, 2013) [25]. Additionally, literacy-based learning devices need to be developed. Literacy is an activity of accessing, understanding something through reading, writing, viewing, listening and speaking activities. Literacy cannot be separated from the world of education. Literacy is a means for students to know, understand, and apply the knowledge gained. Literacy is translated into; early literacy, basic literacy, library literacy, media literacy, technology literacy, and visual literacy (Wiedarti. *et al*, 2018) [39]. Therefore, prospective pre-service teachers can face the development of globalization and the challenges of the 21st century, and the required skills need to be integrated in learning through the development of learning devices. Therefore, the development of learning devices is demanded in learning devices based on PPK, literacy, and skills 4Cs.

In developing learning devices, it must go through research and development. Borg and Gall (1983) [8] defines the development research as educational Research and Development (R&D) is a process used to develop and validate educational products. This is in line with Sugiono (2010) [32], arguing that research and development is a research method used to produce a particular product and test the effectiveness of the product. Meanwhile, according to Dwiyogo (2001) [12], stated three important things in

research and development, namely analyzing needs, developing products, and testing products.

To develope a product, premliminary research is needed in order to determine the needs needed to overcome the problems encountered in learning activities. Thus, it is expected that the resulting product is valid according to need (need based product). According to Setyosari (2013) [30], the needs analysis aims as a preliminary study in developing a product. By examining the needs used to develop a product, the researcher will know a real situation in the actual field. After analyzing the premliminary requirements, an alternative solution is then offered by developing a particular product or design. Requirement analysis is the first step that must be done in research activities in the field of development. This is consistent with the opinion of Borg and Gall (1983) [8], that a need is usually defined as a discrepancy between an existing set of conditions and desired set of conditions. Therefore it is very necessary to conduct premliminary research or analysis of needs to obtain premliminary information in product development.

One development model that can be used to develop a product, the 4D model by Thiagarajan, *et al* (1974) [36], which includes the stages of define, design, develop, and disseminate. The premliminary stage according to the 4D model is the define stage, one of the stages is the analysis of students (students). This analysis aims to bring up and determine the basic problems faced in learning, so we need a product development. With this analysis will get a picture of facts, expectations and alternative solutions to basic problems, which makes it easier to determine or choose the product blueprint.

Based on these descriptions, this study aims to describe the analysis of the need for development of learning devices based on strengthening character education, literacy and 4Cs skills in calculus I to shape 21st century prospective teachers. This learning devices is part of the completeness of the learning process regulated in the Regulation of the Minister of Research in Technology and Higher Education (Permenristekdikti) No. 44 of 2015 [29] concerning National Higher Education Standards (SN Dikti) subsection 12. In detail, the planning of the learning process is presented in the syllabus or semester learning plan and arranged by lecturers either independently or in groups according to their respective expertise. Meanwhile, the components of learning devices that will be developed, include 1) Semester Learning Plan, 2) Teaching Materials, 3) Student Worksheets, 4) Learning Evaluation Tools, and 5) Lecture Contracts. All of these components are developed in accordance with the SN Dikti's standard National Qualification Framework (KKNI) curriculum.

2. Methodology

This research uses descriptive research with the type of survey method, where survey research is research that does not provide treatment to respondents, only collects data using standardized instruments, such as questionnaires, tests and so on (Sugiyono, 2013).

The population in this study were second semester students from universities in Malang. The sample in this study was selected by purposive sampling, which is to choose subjects with specific objectives. The sample in this study were 335 second semester students who have taken calculus I courses from five universities, and 12 lecturers supporting calculus I courses from six universities, namely 1) Wisnuwardhana University Malang (Unidha) as many as 73 students and 2 lecturers, 2) University of Muhammadiyah Malang (UMM) as many as 71 students and 2 lecturers, 3) IKIP Budi Utomo Malang as many as 59 students and 2 lecturers, 4) University of Kanjuruhan Malang (Unikama) as many as 38 students and 2 lecturers, 5) Universitas Islam Malang Universitas Islam Malang as many as 94 students and 2 lecturers, and University of Maulana Malik Ibrahim Malang (UIN Malang) as many as 2 lecturers.

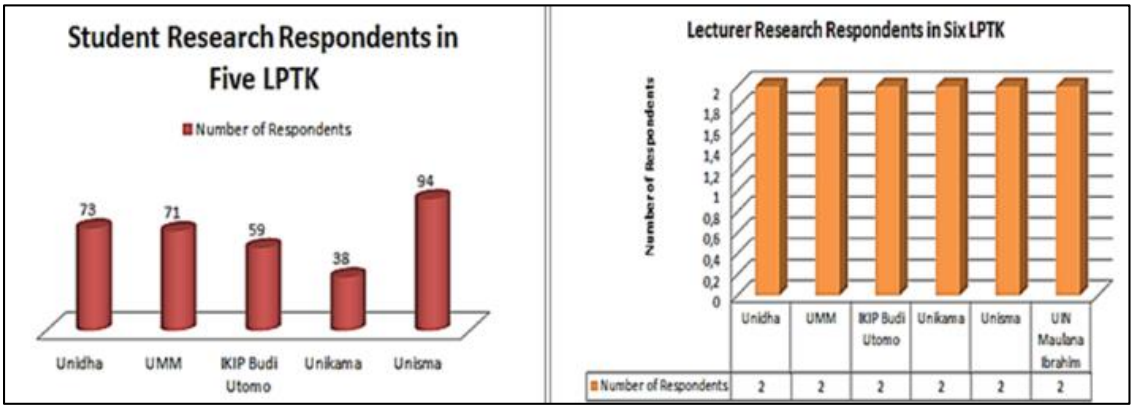

Fig 1: Student and Lecturer as Research Respondents

Data collection techniques in this study, the researcher utilized a set of questionnaire. The questionnaire includes a questionnaire for student needs and a questionnaire for lecturer needs. Therefore, the questionnaire instrument for students and lecturers needs contains a list of statements including the needs used to develop calculus I learning devices. List of statements on the questionnaire for student needs, including, (1) aspects of the need for learning devices based on strengthening character education, literacy and 4Cs skills, include: content, learning models, teaching materials and worksheets, and evaluation of calculus I courses, (2) aspects of the characteristics of calculus I, including how well students understand the material in calculus I, and (3) aspects of learning motivation, including how much motivation students in calculus I learning courses. Then, the list of statements on the questionnaire needs of lecturers includes learning models, teaching materials, worksheets, learning evaluations that have been used in calculus I courses, and a list of statements to give approval when learning devices based on strengthening character

education, literacy, and 4Cs skills will be developed for calculus I course.

Before the distribution of questionnaire for the students and lecturers to collect the data, the instruments were validated by using construct validity by experts (experts' validity). For this reason, the questionnaire that has been made is based on a certain theory, and it was consulted with experts to get responses to the questionnaire. In general, this research goes through several stages, while the specific stages in this study can be seen in Figure 2 below.

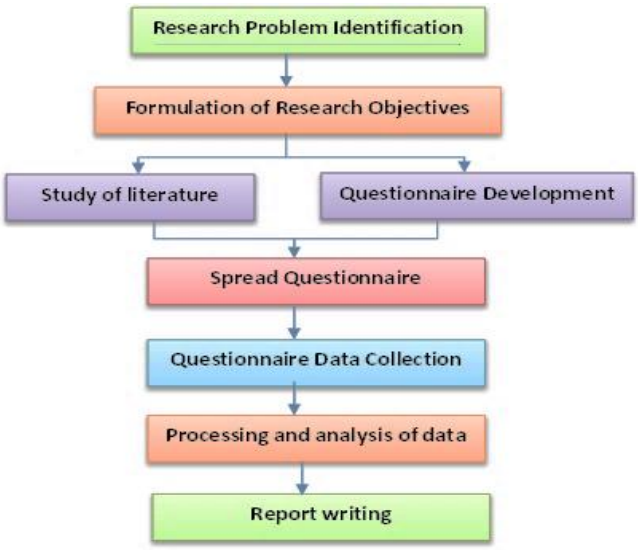

Fig 2: Stages of Survey Research

Data analysis techniques using the steps of the theory of Miles, Huberman and Saldana (2014) [24], including: data condensation, data condensation refers to the process of selecting data, focusing, simplifying, abstracting, and transforming the data that appears in written-up field notes or transcriptions. Presentation of data (data display), is the stage in presenting data in the form of brief descriptions, tables, and charts that illustrate the analysis of research results. Conclusions or verification, is the stage in concluding the data in accordance with the formulation of the problem. The data that has been described is summarized in general.

Survey data from need analysis questionnaires by students and lecturers need to develop learning devices based on strengthening character education, literacy, and 4Cs skills in calculus I, namely quantitative data in the form of questionnaires on a Likert scale and qualitative data in the form of open questionnaires, where respondents can answer the questionnaires based on their experience in learning calculus I.

Before distributing the the needs analysis questionnaire of students and lecturers was used to collect data on respondents, construct validity was first conducted from the opinions of experts (judment experts), namely Indonesian lecturers and Mathematics lecturers at the Islamic University of Malang to determine the eligibility of the questionnaire. The aspects for questionnaire validation include the eligibility of the questionnaire content, the suitability of the questions with the objectives of the questionnaire, the suitability of the questions on the questionnaire (general-specific), language (language in the questionnaire in accordance with EYD, easy to understand language), and sentences in the questionnaire in accordance with the functional elements of writing, such as punctuation, typeface, etc. Based on expert judgment, the results are as shown in Figure 3 below.

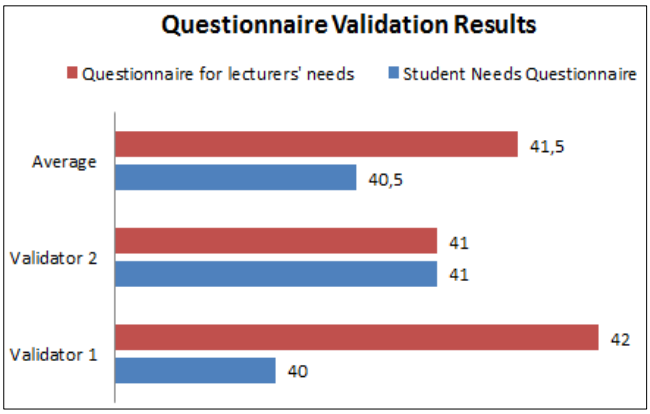

Fig 3: Questionnaire Validation Results

Based on Figure 3, the results obtained by the number of questionnaire validation sheets needed by lecturers from Validator I are 42 and from Validator II the total score is 41, while the total score of questionnaire validation needs of students from Validator I is 40 and from Validator II a total score of 41 is obtained. The average questionnaire score analysis of the needs of lecturers from validators I and II was 41.5. The average number of questionnaire scores analyzed by the needs of students of validators I and II was 40.5. Guidelines for interpreting quantitative data from instrument validation results can be seen in Table 1 below.

Table 1: Interpretation of Instrument Validation Sheet Rating

Final score	Qualification	Judgment
43 – 52	Very good	Eligible to use without revision
33 – 42	Well	Worth using a little revision
23 – 32	Not Really Good	Worthy of use with many revisions
13 – 22	Not Good	Not suitable for use and still needs consultation

Based on Table 1, that the questionnaire analysis needs of lecturers with an average score of 41.5 and the questionnaire needs of students with an average score of 40.5, then both questionnaires were declared good. So it is feasible to use to retrieve the data needed. After the questionnaire analysis of the needs of students and lecturers was declared valid and feasible for data collection, then the questionnaire data was collected by distributing both questionnaires to the research respondents, namely 335 students from 5 universities and 12 lecturers who supported calculus I courses from 6 universities in Malang city. The results of the questionnaire data analysis of the needs of students and lecturers, as described below.

3. Results

3.1 Analysis of Student Needs

This student needs analysis questionnaire covers aspects of the need for the development of learning devices based on strengthening character education, literacy, and 4Cs skills in calculus I courses consisting of 16 questions. So that student questionnaire data was obtained by spreading the questionnaire

to 335 students in 5 LPTK colleges. The presentation of the results of the questionnaire analysis of student needs is presented in Figure 4 and Figure 5 below.

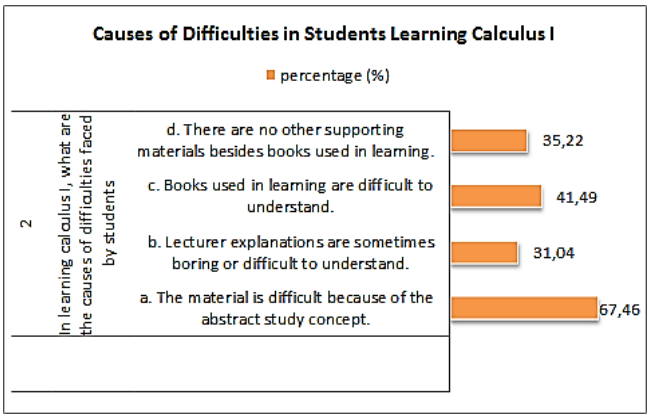

Fig 4: Causes of Difficulties in Students Learning Calculus I

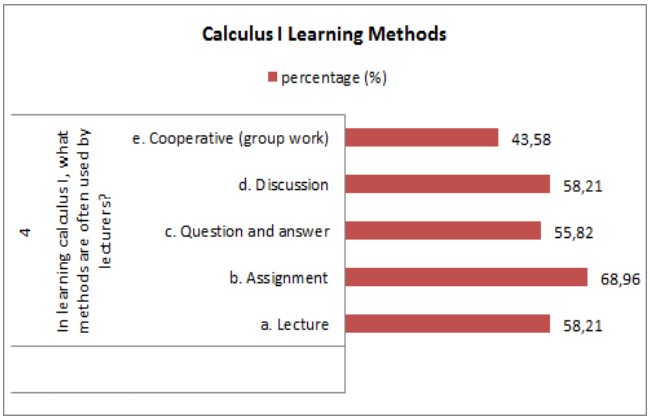

Fig 5: Calculus I Learning Methods

Based on Figure 4, the results emphasis that there are still many students experiencing difficulties, students state that the causes of difficulties, namely as many as 226 (67.46%) students, because calculus I material is difficult to study because of the concept of study abstract, as many as 104 (31.04%) students, because the lecturer's explanation in learning calculus I was boring or difficult to understand. Likewise, there are 139 (41.49%) students stated the causes of difficulties because the books used in learning calculus I were difficult to understand by students, and as many as 118 (35.32%) students, because there were no other supporting materials besides the books used by lecturers in learning calculus I and the book is difficult for students to understand.

Difficulties of students in learning calculus I are supported by the learning methods that have been used by lecturers lack of support for student understanding. Based on Figure 5, the results are obtained that as many as 195 (58.21%) students stated that so far the lecturer used the lecture method, 231 (68.96%) students stated that the lecturer used the assignment method, as many as 187 (55.82%) students stated lecturers used the question and answer method and as many as 195 (55.21%) students said the lecturer Used discussion, there were also 146 (43.58%) students stated the lecturer used the cooperative method. Where the methods that have been used by lecturers are still not maximized to help students in understanding calculus I course materials.

This is also supported by the assessments made by lecturers so far only measure students' cognitive, without measuring other activities, such as student attitudes and skills. According to the questionnaire data in Figure 16, as many as 139 (41.49%) students disagree and 108 (32.24%) students disagree if the final calculus I score is only obtained from midterm and final exam grades. Because it only measures student cognitive, it does not measure student attitudes and skills in the calculus I course. This is as seen in the results of the questionnaire in Figure 6 below.

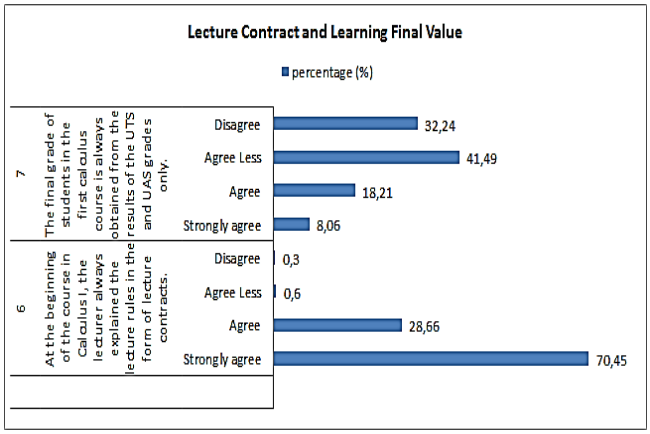

Fig 6: Final Assessment of Calculus I

The impact of the many students who have difficulty understanding materials I calculus, the use of learning methods that do not activate students, and evaluation tools that only measure students' cognitive, will make student competency in understanding material I calculus less than the maximum.

This statement is supported by the results of a questionnaire about the characteristics of student understanding in learning calculus I, seen in Figure 7 through Figure 10, below.

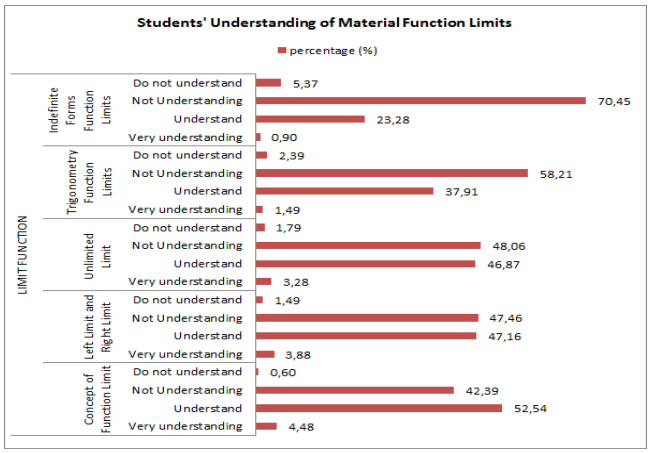

Fig 8: Functional Continuity

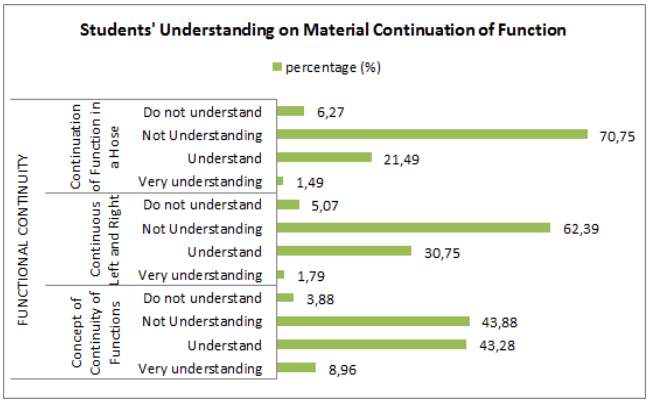

Fig 7: Limit Functions

Based on Figure 7 and Figure 8, it shows that from the number of research respondents as many as 335 students, more than 50% of students still lack understanding and do not understand the material limit function and function continuity. In Figure 7, it appears that in the material limit functions are not understood by students, as many as 195 (58.21%) students lack of understanding and 8 (2.39%) do not understand the trigonometric function sub-material limit, and as many as 236 (70.45 %) students do not understand and 18 (5.37%) do not understand sub-material indefinite forms of function limit. Based on Figure 8, the material continuity of functions that are poorly understood, as many as 209 (62.39%) students lack understanding and 17 (5.07%) do not understand the continuous and right continuous continuous sub-material, and as many as 237 (70, 75%) students do not understand and 21 (6.27%) do not understand the continuity of function sub-material in an interval.

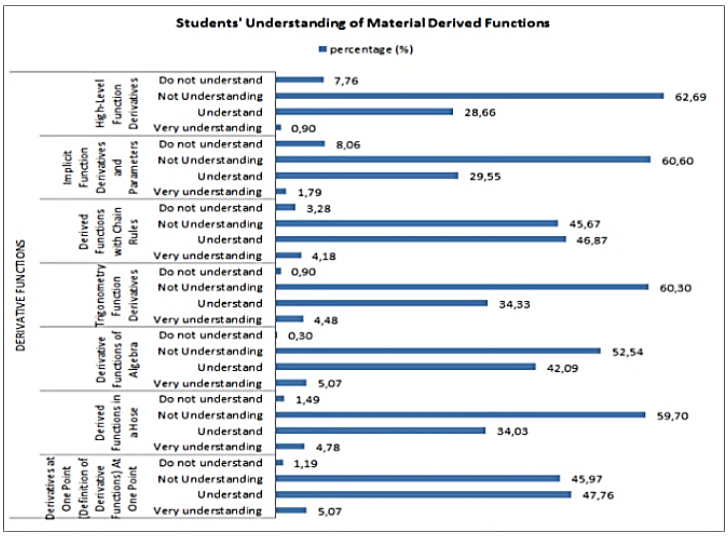

Fig 9: Derivative Functions Figure

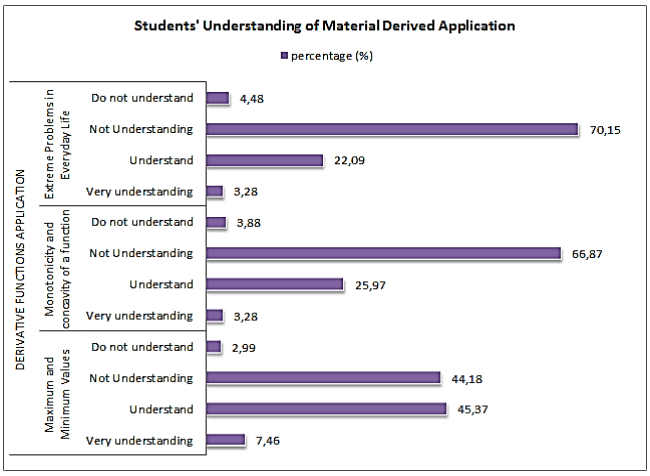

Fig 10: Derivative Functions Application

Likewise, based on Figure 9 and Figure 10, it appears that most students do not understand the other calculus I material, namely the material derived from functions and applications derived from functions. In Figure 9, it can be seen that more than 50% of student respondents lack understanding of functional derivative material, ie 200 (59.70%) students lack understanding of functional derivative sub-material in an interval, as many as 176 (52.54%) students lack understanding of sub-material material derived from algebraic functions, as many as 203 (60.30%) students lack understanding and 27 (8.06%) do not understand the implicit function derivative sub parameters and parameters, and as many as 210 (62.69%) students lack understanding and 26 (7, 76%) did not understand sub-material derived from high-level functions.

Based on Figure 10, it can be seen that the functional derivative application material more than 60% of student respondents did not understand the material, namely 224 (66.87%) students did not understand and 13 (3.88%) did not understand the monotonic and concave sub-material function, and 235 (70.15%) students lack understanding and 15 (4.48%) do not understand sub-material extreme problems in everyday life. So it can be concluded that more than 50% of student research respondents still lack understanding of calculus I materials.

The number of students who do not understand the calculus I materials is caused by many things, including teaching materials, learning methods used by lecturers, and learning evaluation tools that do not support the achievement of student competencies in understanding calculus I material. Therefore it is necessary to develop material teaching, selection of learning methods, and

also the development of evaluation tools for calculus I learning courses that can support the achievement of student competencies in understanding calculus I courses. One way is by developing calculus I learning courses designed based on strengthening character education, literacy, and 4Cs skills with more easy and interesting, so students can easily study the first calculus course. This is also reinforced by the results of the analysis of student questionnaire data and learning motivation questionnaires, as shown in Figure 11 and 12 below.

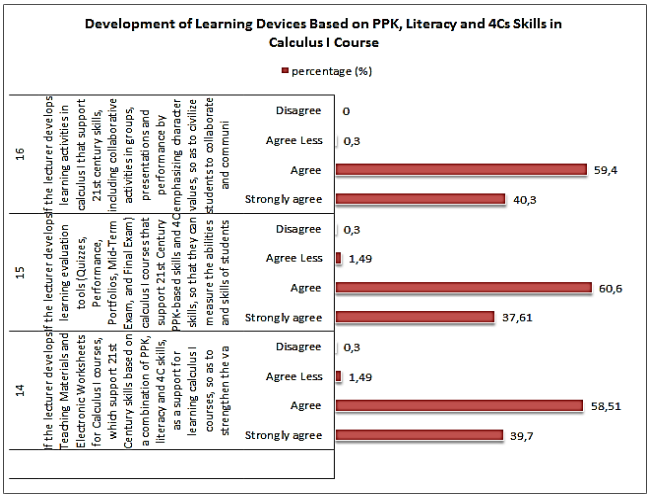

Fig 11: Development of Learning Devices Based on PPK, Literacy and 4Cs Skills in Calculus I Course

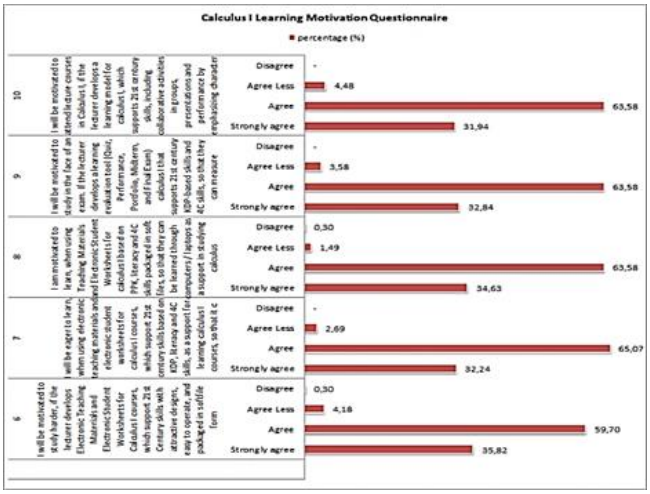

Fig 12: Calculus I Learning Motivation Questionnaire

Based on Figure 11, students agree that when lecturers develop varied electronic teaching materials, as many as 133 (39.7%) students strongly agree and 196 (58.51%) students agree, and Figure 12 on the learning motivation questionnaire, showing 116 (34.63%) students strongly agree and 213 (63.58%) students agree, that students are more motivated to learn calculus I, when lecturers develop teaching materials and electronic worksheets for calculus I courses based on strengthening character education, literacy and 4Cs skills. This is in order to support 21st century skills, and to strengthen the character values of students, foster a culture of reading, and increase the fondness of student literacy, as well as enhance student skills in facing global challenges in the 21st century.

Likewise, students' opinions can be seen in Figure 11, that students agree if the lecturer develops a various learning evaluation tools, which is 126 (37.61%) students strongly agree and 203 (60.6%) students agree, and Figure 12 on the motivation questionnaire learning, showing as many as 110 (32.84%) students strongly agree and 213 (63.58%) students agree, that students are motivated to learn in facing exams, when lecturers develop learning evaluation tools (Quizzes, Performance, Portfolio, mid-term exam, and final test) calculus I courses based on strengthening character educationand 4Cs skills. For that reason, it can be used as the supportive achievement tools of students' skills in the 21st century. If the learning evaluation tool can be developed, it can be used as a lecturer guide to measure the ability and skills of students as a whole, both in the cognitive field, attitudes and skills as the final grade in calculus I.

Based on Figure 11, students agree if the lecturer uses innovative learning methods, as many as 135 (40.3%) students strongly agree and 199 (59.4%) students agree, and Figure 12 on the learning motivation questionnaire, showing as many as 107 (31. 94%) students strongly agree and 213 (63.58%) students agree, that students will be more motivated to take courses in calculus I, if the lecturer develops innovative learning methods for calculus I. This is in order to support the achievement of 21st century skills, including collaboration in groups, presentations and performance by emphasizing character values, so as to civilize students to collaborate and communicate well.

Based on the description of the results of the questionnaire data analysis of the needs of the students above, it can be concluded that as many as approximately 75% of respondents 335 students expressed strongly agree and agree if the lecturer will develop a learning devices for calculus I based on strengthening character education, literacy and 4C skills, as a support for learning calculus I. Learning devicess which will be developed include, semester learning plan (based on strengthening character education, 4C literacy and skills using an innovative learning model based on student centered learning (SCL)), teaching materials (based on strengthening character education, literacy and 4C skills), and learning evaluation tools (measuring cognitive, attitudes and skills of 4Cs students in an integrated manner).

3.2 Analysis of Lecturer Needs

The results of data analysis of lecturer needs were obtained from the distribution of needs analysis questionnaires to 12 lecturers in 6 LPTK colleges. This questionnaire covers aspects of learning tools that have been used by lecturers in learning calculus I, as well as aspects of the needs needed to develop learning tools based on strengthening character education, literacy, 4Cs skills in calculus I. Where the lecturer needs questionnaire consists of 18 questions.

The presentation of the results of the questionnaire data analysis needs of lecturers is presented in Figure 13 and Figure 17 below.

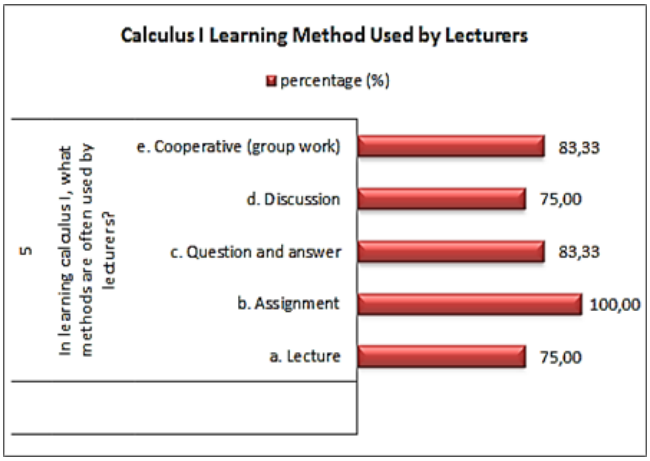

Fig 13: Calculus I Teaching Materials Used by Lecturers

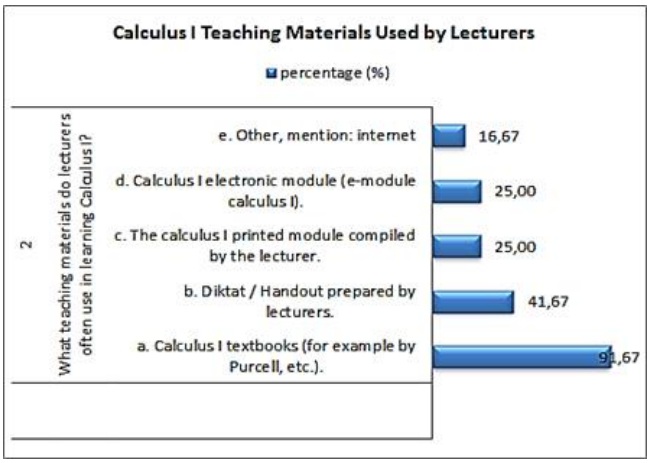

Fig 14: Calculus I Learning Method Used by Lecturers

Based on Figure 13, shows that teaching materials that are often used by lecturers in learning Calculus I courses, namely as many as 11 (91.67%) lecturers use calculus textbooks (such as Calculus I by Purcell, etc.), as many as 5 lecturers (41, 67%) lecturers use textbooks or handouts made by lecturers, 3 (25%) lecturers use the first calculus print module made by lecturers, 3 (25%) lecturers use the calculus I electronic module (e module calculus I) made by lecturers, and there are only 2 (16.67%) lecturers who use internet-based calculus I teaching materials.

Based on Figure 14, shows that the learning methods that are often used by lecturers in learning calculus I, as many as 9 (75%) lecturers use the lecture method, as many as 12 (100%) lecturers use the assignment method, as many as 10 (83.33%) lecturers use question and answer method, 9 (75%) lecturers used the discussion method, and 10 (83.33%) lecturers used the cooperative method (group work).

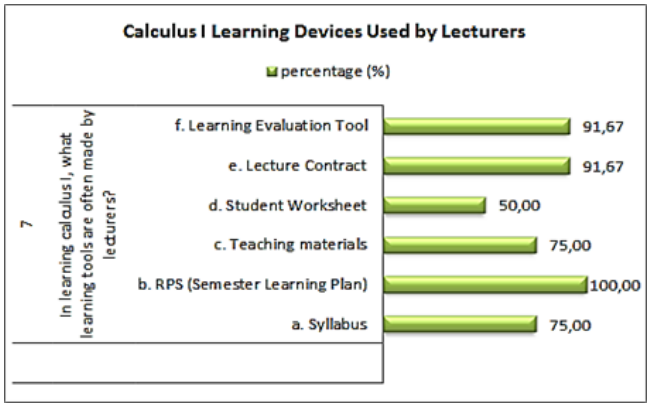

Fig 15: Calculus I Learning Devices Used by Lecturers

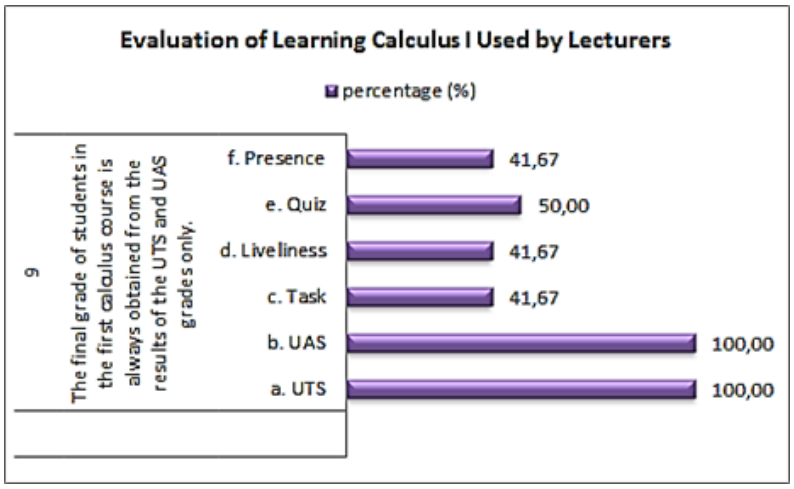

Fig 16: Evaluation of Learning Calculus I Used by Lecturers

Based on Figure 15, it shows that as many as 9 (75%) lecturers make calculus I syllabus, as many as 12 (100%) lecturers make semester learning plan for calculus I courses, as many as 9 (75%) lecturers make teaching material for calculus I, as many as 6 (50 %) lecturers make work on calculus I worksheets, as many as 11 (91.67%) lecturers make contracts on lectures on calculus I and submit them to students, and as many as 11 (91.67%) lecturers make evaluation tools on learning calculus I even though they have not varied.

Based on Figure 16, it shows that evaluation tools that are often used by lecturers in learning calculus I, as many as 12 (100%) lecturers do mid-term examto measure student competency in calculus I subjects, as many as 12 (100%) lecturers do final test to measure student competency in calculus I, and only 5 (41.67%)

Lecturers used independent assignments to measure student competency in calculus I, as well as only 5 (41.67%) lecturers used student activity to measure student competency in calculus courses I, as many as 6 (50%) lecturers gave quizzes to measure student competency in learning calculus I, and only 5 (41.67%) lecturers used student presence or attendance in learning as indicators to determine the final grade of calculus I.

Based on the descriptions from Figure 13 to Figure 16, it shows that most of the lecturers use ready-made teaching materials (Purcell's first calculus book) and other calculus books, this results students got difficulties in understanding the concepts of Calculus I. Further, the study of these books is not necessarily in accordance with the characteristics of students. Likewise, the learning method that is often used by lecturers in learning calculus I, namely the lecture method and the assignment method, results students to be passive in learning and unable to show their creativity. During this calculus I, learning device made by lecturers only make RPS calculus I course only. Thus, it shows that most lecturers do not develop teaching materials, various evaluation tools. Likewise, the learning evaluation tool used by lecturers to measure students' abilities are only midterm and final exam. While other evaluation tools, such as quizzes, independent assignments, activeness, and attendance are rarely used as indicators of determining the students' final score in calculus I.

Therefore it is necessary to change the lecturers' teaching methods in carrying out calculus I, and the lecturers need to develop supportive learning tools and provide convenience to students in understanding the calculus I course. This can be seen from Figure 17 below.

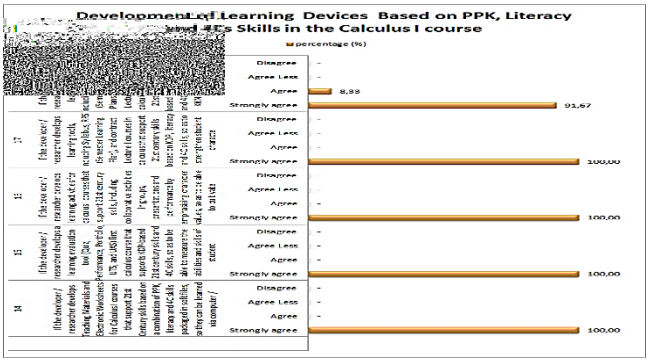

Fig 17: Development of Learning Devices Based on PPK, Literacy and 4Cs Skills in the Calculus I course

Based on Figure 17, it shows that all 12 (100%) lecturers strongly agreed when developing teaching materials based on strengthening character education, literacy and 4Cs skills in calculus I that support 21st century skills in the form of soft files. So it is easy for students to learn whenever and wherever. Figure 17 also shows that all respondents strongly agreed, if evaluation tools (Quizzes, Performance, Portfolio, Mid-Term Exam, and Final Test) were developed and could strengthen character education and 4Cs skills. So that it can measure the ability and skills of students as a whole, including cognitive, attitude and skills. Meanwhile, Figure 17 shows that all lecturers strongly agreed when lecturers use innovative learning methods, including collaboration in groups, presentations and performance, so they can civilize students in collaborating and communicating. Additionally, all lecturer strongly agree if learning devices based on strengthening character education, literacy and 4Cs skills are developed in accordance with KKNI and SN Dikti, including semester learning plan, teaching materials, learning evaluation tools, and contract calculus courses for calculus I to support 21st century skills. This effort aims to strengthen the character values of students, foster a critical and analytical culture of students in reading, and improve student's skills as prospective teachers in facing global challenges in the 21st century.

Based on the description of the results of lecturers' needs analysis, it can be concluded that all lecturers as the respondents stated strongly agree if the calculus I learning course was developed based on strengthening of character education, literacy and 4Cs skills, as a support for learning calculus I subjects that can strengthen the values student character, fostering a culture of reading, and can improve student literacy craze, and improve student skills in facing global challenges in the 21st century. Therefore, the learning devices to be developed include, semester learning plan (based on strengthening of character education, literacy and 4C skills by using innovative learning models based on student centered learning (SCL)), teaching materials (based on strengthening of character education, literacy and 4C skills), and learning evaluation tools (measuring cognitive, attitudes and 4Cs skills of students in an integrated manner).

3.3 Discussions

The objective of this study is to describe the need for developing learning devices based on strengthening character education, literacy, and valid 4Cs skills in calculus I course. In order to obtain a valid learning device, one of the stages is by conducting premliminary research which aims to obtain the data needed to develop a valid learning tool by conducting a needs analysis questionnaire on research respondents of students and lecturers. The analysis of the development needs of learning devices is essential as the first step in development research. After the premliminary data is obtained, then subsequently gradually develop a product until a good product is obtained.

Based on the results of preliminary research, obtained from the questionnaire data of the needs of students and lecturers, the students' mastery in calculus I material is still lacking, and this is because calculus I teaching materials are difficult to understand, learning methods used by lecturers cannot activate students, and learning evaluation tools are less supportive to measure student competency. If this case is ignored, it will cause the competence of students in understanding the material of calculus I to be less optimal. Therefore it is necessary to develop teaching materials,

selection of learning methods, and development of evaluation tools for calculus I learning courses that can support student competencies in understanding calculus I subjects. One way is to develop learning devices for calculus I based on strengthening of character education, literacy, and 4Cs skills more easily and interestingly, so students can learn easily.

The purpose of this development is to assist the students in understanding, representing, noticing, interpreting the concepts, and posing their own questions related to the task (Galligan, 2019) [14]. This is also supported by the statement of Suyanto (2012) [35], that professional teachers are teachers who are always changing from old practices, even willing and able to leave the methods and models of learning used in the past to face the challenges of the present and the future. Finally, Swarsauslander (2019) concluded that It is a requirement for the in service and pre-service teachers to be able to develop and adapt learning assessment in order to analyze the students problems such as errors, confusions, and partial understandings.

Likewise, if lecturers can develop good teaching materials, namely teaching materials based on strengthening of character education, literacy, and 4Cs skills, it will make it easier for students to understand calculus I material well. This is in accordance with the guidelines for the development of teaching materials delivered by the Ministry of National Education (2007), that the function of teaching materials is to guide lecturers and students so that they can direct all their activities in the learning process, as well as an evaluation tool for learning achievement. The function of teaching materials is also highly related to the ability of lecturers to make decisions related to planning (planning), learning activities and implementing (implementing), and assessment (assessing). Likewise if the lecturer in implementing learning uses innovative learning methods, it will be able to activate students in learning. This is in accordance with Joyce and Weils' theory (2011) that the approach implemented by lecturers must be able to develop learning activities, lecturers must be able to plan learning activities well, then implement the plans that have been made, and finally be able to assess the success of their activities well.

Likewise, the results of questionnaire data analysis of the needs of students and lecturers related to the development of learning tools, it can be concluded that all lecturers and approximately 75% of students as research respondents stated strongly agree and agree, when calculus I learning course tools are developed based on the strengthening of character education, literacy and skills 4Cs, as a support for learning calculus I. So that it can strengthen the values of student character, foster a culture of reading, and can increase the fondness of student literacy, and improve student skills in facing global challenges in the 21st century. Learning devices to be developed include, semester learning plan (based on strengthen ing character education, literacy and 4Cs skills using innovative learning models based on student centered learning (SCL)), teaching materials (based on strengthening character education, literacy and 4Cs skills), and learning evaluation tools (measuring cognitive, attitudes and 4Cs skills of students in an integrated manner). This is supported by his opinion Trilling and Fadel (2009) [37] and As'ari (2016) [3], so that students (prospective teachers) can face the challenges of the 21st century, then students (prospective teachers) Mathematics must master teacher competencies in accordance with RI Law No. 14 in 2005, namely educational competence, professional competence, personality competence, and social competence. Also must master Learning and Innovation Skills (4Cs), including mastering the development of ICT, and mastering the skills of 4Cs which is the 21st Century Skills. The 4Cs skills referred to include (1) Critical Thinking, (2) Communication, (3) Collaboration and (4) Creativity.

Development of learning devices based on strengthening character education, this is supported by the opinion of Gunawan (2012), that the formation of pre-service teacher candidates or professional teachers aims to have a strong soul, never give up, be competitive, moral, moral, tolerance, mutual cooperation, work hard, understand science and technology, and have faith and devotion to God Almighty based on Pancasila. Also Soetanto's opinion (2012) [31] revealed that one of the strategies used in the application of character education is through learning strategies that can be done in every course in the fields of science and technology.

The development of literacy-based learning devices is supported by the opinion of Koswara (2018), that literacy activities are very important to be carried out by students because they can improve the ability to find, analyze, and read fondness among students, through various kinds of literacy activities, including 1) digital scientific literacy, understand theory and science, including the use of science and Mathematics using digital technology; (2) information literacy, the ability to find and utilize information from various digital sources and references; (3) digital functional literacy, the ability to understand and convey thoughts through a variety of media, including the use of images, videos, graphics, charts or visual literacy; (4) technology literacy, a component in the use of technology, especially technology that helps work as a productive teacher; (5) cultural literacy, the ability to understand and adapt to diverse cultures through access to digital technology.

4. Conclusions

Based on the analysis of questionnaire data needs of students and lecturers related to student mastery in calculus I, it shows that there are still many students who do not understand the calculus I material, caused by many things, including teaching materials, learning methods used by lecturers, and evaluation tools learning that is less supportive in measuring student competency in understanding the calculus I material. Based on the analysis of student needs questionnaire data, it can be concluded that as many as approximately 75% of respondents 335 students expressed strongly agree and agree, when calculus I learning devices are developed based onstrengthening character education, literacy and 4Cs skills. This was also reinforced by the opinion of lecturers that 12 (100%) respondents strongly agreed, if calculus I learning devices are developed based onstrengthening character education, literacy and 4Cs skills, as a support for learning calculus I. So as to strengthen the values of student character, fostering culture reading, and increasing student literacy craze, as well as improving student skills in facing global challenges in the 21st century.

5. References

1. Adler J. Conceptualising resources as a theme for teacher education. Journal of Mathematics Teacher Education, 2000; 3:205-224.
2. Akker JV. Design Approaches and Tools in Education and Training. Dordrecht: Kluwer Academic Publishers, 1999.

3. As'ari Abdurrahman. Menjawab Tantangan Pengembangan 4C's Melalui Pengembangan Kurikulum dalam Pembelajaran Matematika. Prosidding Seminar Nasional Pendidikan Matematika UM Penerbit CV. Bintang Sejahtera Anggota IKAPI (No: 136/JTI/2011), 2016.
4. Assor A. Allowing choice and nurturing an inner compass: Educational practices supporting students' need for autonomy. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), Handbook of research on student engagement (pp. 421–439). New York: Springer, 2012.
5. Auslander SS. Smith SZ, Smith ME, Myers K. A case study of elementary teacher candidates' preparation for a high stakes teacher performance assessment. Journal of Mathematics Teacher Education, 2019. DOI: https://doi.org/10.1007/s10857- 018-09422-z
6. Berkowitz MW, Bier Melinda C. What Works In Character Education: A Research-driven guide for educators. Washington, DC: Univesity of Missouri-St Louis, 2005.
7. Bobis J, Khosronejad M, and Way J, Judy Anderson J. "Sage on the stage" or "meddler in the middle: shifting mathematics teachers' identities to support student engagement. Journal of Mathematics Teacher Education, 2019. DOI: https://doi.org/10.1007/s10857-019-09444-1
8. Borg WR, Gall MD Gall. Educational Research: An Introduction, Fifth Edition. New York: Longman, 1983.
9. BSNP. Permendiknas RI No. 22 Tahun 2006 tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah. Jakarta, 2006.
10. Chu Wah SK. *et al*. 21st Century Skills Development Through Inquiry-based Learning: From Theory to Practice. Springer, Singapore, 2017.
11. Depdiknas. Permendiknas No 22 Tahun 2006 Tentang Standar Isi. Jakarta: Depdiknas, 2006.
12. Dwiyogo Wasis D. Konsep Penelitian dan Pengembangan, Pusat Kajian Kebijakan Olahraga. LEMLIT: Universitas Negeri Malang, 2004.
13. Galbreth J. Preparing the 21st Century Worker: The Link Between Computer-Based Technology and Future Skill Set. Educational Technology, Vol XXXIX, Number 6, November-Desember, 1999.
14. Galligan L, Axelsen T, Pennicott T, Addie R, Galbraith P, Woolcott G. *et al*. It's part of my life and the modeling process. Journal of Mathematics Teacher Education, 2019. DOI: https://doi.org/10.1007/s10857-019-09426-3
15. Heri G. Pendidikan Karakter; Konsep dan Implementasinya, Alfabeta: Bandung, 2012.
16. Hanan I. Aspects of Critical Thinking in Classroom Instruction of Secondary School Mathematics Teachers in Jordan. [Online] Tersedia: http://dipmat.math.unipa.it/pdf. Diakses: 14 Januari, 2011.
17. Iskandar. Metodologi Penelitian Pendidikan dan Sosial (Kuantitatif dan Kualitatif). Jakarta: GP Press, 2008.
18. Joyce Bruce, Weil M, Calhoun E. Models of Teaching: Model-model pengajaran. Di-Indonesiakan oleh Achmad Fawaid dan Ateilla Mirza. Yogyakarta: Pustaka Pelajar, 2011.
19. Kemendikbud. Gerakan Literasi Nasional. TIM GLN Kemendikbud: Jakarta, 2017.
20. Endang K. Penguatan Pendidikan Karakter dan Pembelajaran Abad 21. SIPATAHOENAN: South-East Asian Journal for Youth, Sports & Health Education, 2018; 4(1).
21. Donald RL, John WK, Iris BR, Sherry B. Calculus Concepts: An Applied Approach to the Mathematics of Change, Cengage Learning, 2007. hlm. 2, ISBN 0-618-78981-2, Chapter 1, p 2
22. Martin A. "Literacies for Age Digital Age" dalam Martin & D. Madigan (eds), Digital Literacies for Learning. London: Facet, 2006.
23. Metiri Group. enGauge 21st century skills for 21st century learners, 2003. Retrieved October 29, 2018 from http://www.metiri.com/21/Metiri-NCREL21stSkills.pdf
24. Miles MB, Huberman AM, Saldana J. Qualitative Data Analysis, A Method Sourcebook, Edition 3. USA: Sage Publications. Terjemahan Tjetjep Rohindi Rohidi, UI-Press, 2014.
25. Mulyasa. Manajemen Pendidikan Karakter. Bandung: Bumi Aksara, 2013.
26. Murphy MM. Character Education in America's Blue Ribbon Schools. Lancaster PA, Technomic, 1998.
27. Partnership for 21st Century Skills (P21). Framework for 21st Century Learning. Diakses 5 Agustus 2019, 2013. dari http://p21.org/
28. Partnership for 21st Century Skills. P21 Framework Definitions. Washington, DC: Partnership for 21st Century Skills, 2009.
29. Permenristekdikti Nomor. 44 Tahun tentang Standar Nasional Pendidikan Tinggi (SN-Dikti) Pasal 12: Jakarta, 2015.
30. Setyosari P. Metode Penelitian Pendidikan dan Pengembangan. Jakarta: Kencana, 2013.
31. Soetanto H. Pendidikan Karakter. Malang: Univ. Brawijaya, 2012.
32. Sugiono. Metode Penelitian Kuantitaif, Kualitatif, dan R & D. Bandung: Alfabeta, 2013.
33. Suhadi. Petunjuk Perangkat Pembelajaran. Surakarta: Universitas Muhamadiyah, 2007.
34. Suryabrata S. Pengembangan Alat Ukur Psikologis. Yogyakarta: Andi Offset, 2000.
35. Suyanto, Djihad Asep. Bagaimana Menjadi Calon Guru dan Guru Profesional. Yogyakarta: Multi Pressindo, 2012.
36. Thiagarajan Sivasailam. *et al*. Instructional Development for Training Teachers of Exceptional Children. Washinton DC: National Center for Improvement Educational System, 1974.
37. Trilling B, Fadel C. 21st Century Skills, Learning for Life in Our Times. US America: Jossey-Bass, 2009.
38. Undang-Undang RI, Nomor 20 Tahun tentang Sistem Pendidikan Nasional. Jakarta, 2003.
39. Wiedarti Pangesti. *et al*. Gerakan Literasi Sekolah. Jakarta: Dirjendikdasmen, 2018.