Content Analysis of Al-Islam and Kemuhammadiyahan Values on Multivariable Calculus Materials

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Abstract: The purpose of this research is to build a category of vector field material in Multivariable Calculus learning into the values of Al Islam and Muhammadiyah. The content analysis method uses MaxQDA to code the terms that emerge from the interview texts generated by the participants related to the intersection of the two subjects. The selection of participants is important in order to avoid bias in the description of the interview. Participants were selected 5 out of 31 students based on their knowledge of Multivariable Calculus material and experience in participating in organizational activities of the Muhammadiyah Student Association and the Orientation of Islamic Fundamentals. The results showed that there were three key categories, namely, death, hard work, and brotherhood. Since the vector principle is the same as the beginning of life and the final destination of a person, vector material is closely related to death. Likewise, integral material has a connection with hard work because the principle of line integral can be seen in line with the efforts made by someone. The vector field material is related to the theme of brotherhood because the principle of the vector field is in groups that can be seen as a collection of people.

Keywords: vector field, islam, muhammadiyah, multivariable calculus.

Abstrak: *Tujuan penelitian ini adalah membangun kategori dari materi medan vektor dalam pembelajaran Kalkulus Peubah Banyak ke dalam nilai-nilai Al Islam dan Kemuhammadiyahan. Metode content analysis menggunakan MaxQDA untuk mengkodekan istilah-istilah yang muncul dari teks wawancara yang dihasilkan partisipan terkait dengan perpotongan dari dua buah subjek. Pemilihan partisipan menjadi penting agar terhindar dari bias deskripsi wawancara. Partisipan dipilih 5 dari 31 mahasiswa berdasarkan keilmuan pada materi kalkulus Peubah Banyak dan pengalaman dalam mengikuti kegiatan organisasi Ikatan Mahasiswa Muhammadiyah dan Orientasi Dasar-Dasar Islam. Hasil penelitian menunjukan bahwa terdapat tiga kategori kunci yaitu, kematian, kerja keras, dan persaudaraan. Karena prinsip vektor sama dengan awal kehidupan dan tujuan akhir seseorang, maka materi vektor erat kaitannya dengan kematian. Begitupula materi integral yang memiliki keterhubungan dengan kerja keras karena prinsip integral garis bisa dilihat sejalan dengan usaha yang dilakukan seseorang. Adapun materi medan vektor yang memiliki keterkaitan dengan tema persaudaraan karena prinsip medan vektor bekelompok yang dapat dilihat seperti kumpulan orang.*

Kata kunci: *medan vektor, islam, muhammadiyah, kalkulus peubah banyak.*

▪ **INTRODUCTION**

Integration of the values of Al-Islam and Kemuhammadiyahan (AIK) in learning and study of scientific disciplines at the University of Muhammadiyah Prof. Dr. Hamka (Uhamka) is claimed to have meaning, eliminating the paradigm of secularism and developing science based on the value of monotheism (Chaerunnisa, 2017). One of the research results found related to understanding concepts in the Kemuhammadiyahan course is the tendency of the ability to understand concepts of Uhamka Mathematics

Education Study Program students who are claimed to not have a good understanding (Hadi & Faradillah, 2018). On the other hand, AIK values in mathematical concepts are claimed to play an important role in shaping the nation's character (Maarif, 2015).

Efforts to integrate AIK values into mathematics material have been carried out, such as the research by Fahrurrozi et.al in 2020 in the development of mathematics learning tools integrated with Islamic values, at the analysis stage, it has not shown how the systematic integration of Islamic values is carried out on the number material. rounds and fractions (Fahrurrozi et al., 2020) Likewise, research conducted by Wulantina in 2018 has not shown a systematic technique of integrating Islamic values into the material (Wulantina, 2018). The search results of researchers in Google Scholar regarding the integration of Islamic and Muhammadiyah values have not been encouraging. There is one study by Supriadi et.al in 2019 on the integration of Islamic values in Calculus, but it has not shown categorization in analyzing the integration of Islamic values in Calculus courses (Nanda et al., 2020).

Difficulties in conducting AIK integration research in courses are due to lack of knowledge about content analysis methods. The search results of content analysis research from 2013 show a lack of integration of theory, research, and practice is generally recognized in the profession as a desirable goal (Sampson et al., 2014). This may not be entirely true because the results of observations related to integration research in courses on Google Scholar show several articles. For example, the integration of the history of mathematics in textbooks was successful and provided knowledge of six different views (Eren et al., 2015). In addition, the integration of the history of mathematics embedded in videos and used in learning resulted in two themes and 9 sub-themes according to gifted children (Karatas-Aydin & Isiksal-Bostan, 2022).

Research related to content analysis has also been carried out, such as content analysis research on mathematical modeling which shows that mathematical modeling has not reached the desired level and most other research results emphasize case studies and experiments (Aztekin & Şener, 2015). Research on student success in learning physics that is integrated with mathematics shows several basic factors, namely intelligence, gender, motivation, attitude, self-sufficiency, socioeconomic level, previous learning, teaching and learning approaches and learning methods (Guzel, 2004). Then related to the integration of social issues in mathematics learning, it shows that there are several situational themes from the integration carried out, namely democratic values, awareness of justice, and social equality (Turkkan & Karakus, 2018).

Research content analysis was also used to map the effect of problem-based learning strategies on STEM integration and student attitudes which resulted in STEM-related categories (Lou et al., 2011). The integration of STEM in student teacher candidates resulted in a recommendation that STEM education would encourage students to think, turn theoretical knowledge into practice, and acquire skills to acquire concrete products by using the theoretical knowledge they acquired in class (Uğraş & Genç, 2018). The content analysis on STEM integration shows that there are three categories, namely concept knowledge, curriculum, and implementation of STEM education (Firat, 2020).

Research content analysis is also used to categorize technology integration in learning English as a foreign language which shows several categories, namely primary

school students, middle school students, high school students, university students, teachers, instructors, and new categories such as pre-service teachers. , language school student (Basar & Sahin, 2022). In addition, research using content analysis can produce categories in environmental literacy carried out in the elementary school science curriculum which produces six categories and 40 sub categories (Erdoğan et al., 2009).

Content analysis can also be used to evaluate an approach to learning mathematics using Flipped Classroom and Khan Academy which resulted in 4 categories and 16 sub-categories from interviews with students (Zengin, 2017). Furthermore, the results of research on the integration of technology in mathematics learning state that there are several influential factors, namely teacher-based, student-based, content-management-based-source-time methods, and other technical matters (Kaleli-Yilmaz, 2015).

Research on integration in elementary school mathematics learning also uses content analysis such as the integration of agriculture into mathematics learning which shows eleven categories of the importance of such integration (Satiansiriwiwat et al., 2018). This was also carried out on the integration of elementary school students' literacy in learning mathematics which resulted in seven categories of student interviews about mathematics book opinions (Durmaz & Miçooğullari, 2021).

This research is expected to be able to provide a solution for how to arrange the categorization of AIK values in the Calculus course. According to literature research by Samsul Maarif in 2015, it is necessary to develop continuous analysis of mathematical material by linking the verses contained in the Al-Quran which is the source of all sources of knowledge that can be taken by every human being through mathematics (Maarif, 2015). The preparation of categorization of a subject matter using content analysis method has been widely used to make categorization. The content analysis method has a good systematic and structure to build the main categories that are very useful from the analysis of a mathematical material (Wulandari & Isya, 2020).

AIK values according to the guidelines for the Islamic life of Muhammadiyah members, there are 11 branches of life activities, namely 1) personal, 2) family, 3) community, 4) organization, 5) business charity, 6) business, 7) profession, 8) nation and state, 9) environment, 10) science and technology, and 11) arts and culture (Muhammadiyah, 2000). The Multivariable Calculus course in the UHAMKA Mathematics Education Study Program is an advanced Calculus course that requires students to think at a higher level to study it. Therefore, several researchers have tried to uncover the difficulties of students in learning Multivariable Calculus, including the results of research by Kashefi et.al in 2010 claiming that the most important difficulty for students is to sketch the function of two variables in three dimensions (Kashefi et al., 2010).

New methods and tools for lecturers to teach Multivariable Calculus courses as variations in teaching are claimed to increase effectiveness in learning (Kashefi et al., 2012). In terms of methods, according to Al Faruq, in 2020 claimed that Muhammadiyah was making breakthroughs in the field of education (Faruq, 2020). One alternative way of teaching Multivariable Calculus based on Muhammadiyah ideals is to integrate AIK values into course material.

This study aims to compile the categorization of AIK values in the Multivariable Calculus course and is expected to inspire the lecturers of this course to more easily integrate AIK values in the learning process in the Muhammadiyah Higher Education

environment. In addition, there are still many research themes on Multivariable Calculus that have not been studied, such as graphic themes which can be seen from the perspective of AIK (Joko Soebagyo & Putri, 2022). The results of this study will be used as reference material and publications to disseminate information related to the category of AIK values in the Multivariable Calculus course.

▪ **METHOD**

Participants

The selection of participants was carried out using a sampling technique with the condition that students who have taken the Multivariable Calculus course and have attended Darul Arqam and are active in the Muhammadiyah Student Association. Based on these conditions, five of the 31 students were selected to represent. However, one of the five participants withdrew so that the data in this study were only four people.

Research Design and Procedures

One way to get the integration of AIK values into Multivariable Calculus is to use content analysis. Objectively, according to Pool, content analysis consists of 3 things, namely 1) describing the text; 2) draw conclusions from the text to its antecedents; and 3) draw conclusions from the text until the effect appears (Bikner-Ahsbahs et al., 2015). The content analysis of the integration of AIK with Multivariable Calculus was carried out using MaxQDA with the hope of building the main category system and the codes in it from the intersection of the two subjects. The code generated is based on the results of interviews from participants by understanding the narrative (Rädiker & Kuckartz, 2020) regarding the values of Al-Islam and Kemuhammadiyahan and the Multivariable Calculus material with the type of inductive category formation with 7 steps (Bikner-Ahsbahs et al., 2015). The research was carried out starting from the preparation of interview guidelines and interview validation on April 14, 2021 by two AIK lecturers, and then FGD was conducted on the research progress. The interview was conducted in June 2021 and the analysis was carried out in January 2022.

The research procedure begins with the first step, namely conducting AIK analysis and the theory of Multivariable Calculus. Furthermore, the second step is the establishment of selection criteria, category definition and level of abstraction. In the third step, category formulation is carried out through line by line material and subsumptions or new category formulations. The fourth step is to revise the categories from the results of student interviews after 10% to 50% of the material. In the fifth step, refinement of the categories to completion and the sixth step build the main categories. The last step is to analyze the frequency of categories that emerge from the results of the analysis and interpret them.

Instrument

The qualitative content analysis research method was used to explore the values of Al Islam and Kemuhammadiyahan in the Multivariable Calculus course. Exploration was carried out by conducting structured and semi-structured interviews with students of Mathematics Education, Faculty of Teacher Training and Education, UHAMKA.

The data collection technique in this study used a structured interview technique consisting of three parts, namely personal life, family life and social life. The full interview structure can be seen in the following table.

Table 1. Interview list

Aspect	Sub Aspect
Part 1 – Personal Life (RK, Pos. 2)	How do you relate vector field material to faith values? Give examples and arguments (Al Qura'an or Hadith of the Prophet). (RK, Pos. 3)
	How do you relate the vector field material to the value of monotheism? Give examples and reasons. (RK, Pos. 5)
	How do you relate the vector field material (line and work integral) to the value of hard work and discipline? Give examples and reasons. (RK, Pos. 7)
	How do you relate the vector field material (line and work integral) to the maximum/optimal effort value to achieve a goal? Give examples and reasons. (RK, Pos. 9)
Part 2 – Family Life (RK, Pos. 11)	How do you relate vector field materials such as the following image to the value of having social care and building ihsan, ishlah, and ma'ruf social relationships with neighbors and in wider social life in society? Give examples and reasons. (RK, Pos. 12)
	How do you relate vector field material to the value of respecting the freedom of others? Give examples and reasons. (RK, Pos. 14-15)
Part 3 – Social Life (RK, Pos. 16)	How do you relate vector field material to the value of fostering a sense of brotherhood and fostering a spirit of tolerance? Give examples and reasons. (RK, Pos. 17)

The interview list in Table 1 was adapted and compiled based on the Guidebook for the Islamic Life of Muhammadiyah Citizens by taking several sections that were adapted to the Multivariable Calculus material. Personal Life is used to reflect on participants' experiences after attending lectures and activities of Al Islam and Kemuhammadiyahan. Life in the family is used to reflect the experience of participants in the family environment on the material Calculus of Multiple Variables and Al Islam Kemuhammadiyahan. Community life is used to see participants' experiences in a wider scope related to understanding after participating in these activities.

Data Analysis

The data analysis technique used to conduct content analysis is text analysis using MaxQDA to build categories from the results of participant interviews through a code system (Bengtsson, 2016) line by line of text (Rädiker & Kuckartz, 2020) related to the integration of AIK values in the Variable Calculus material. Lots. Figure 1 shows the stages of research carried out in 7 steps, where in the first step, the AIK analysis process is carried out by the method of classifying AIK values from 11 activity branches which is then followed by a google scholar search regarding the theory of AIK integration in mathematics material. Analysis of the Multivariable Calculus material was carried out

through at least 10 references to teaching materials and relevant research results.

In the second stage, the stage of forming selection criteria, category definition and level of abstraction was carried out through interviews and then the results of the interviews were analyzed using MaxQDA assisted text analysis. If material that meets the definition is found, a category is established. The third stage, the analysis stage through line by line material, category formulation, and subsumption or formulation of new categories. This stage is carried out after obtaining the definition of categories and temporary categories are built, and the material is analyzed line by line. If the results of the analysis of one line of material do not fall into one category, a new category formulation will be made.

In the fourth stage, the category revision stage after 10–50% of the material is carried out if after material analysis. If a new category is found, it returns to the second stage. If a new category is not found, it will enter the fifth stage, namely the final work stage through the material continued to 100%. In text analysis using MaxQDA, the category system is expected to have been built. The sixth stage, the stage of building the main categories if useful. In general, the main category system constructed using MaxQDA has been developed systematically.

The analysis, category frequency, and interpretation stages are carried out after stages 1-6 are carried out. Some displays of categorization results using MaxQDA in the form of tables, diagrams and file summaries. These results are then interpreted in the hope that the categorization of AIK values in Multivariable Calculus has been established.
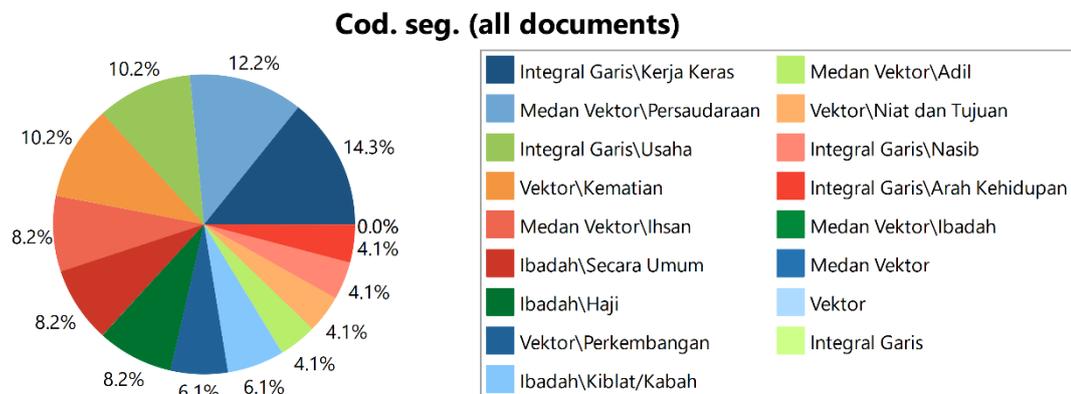
▪ **RESULT AND DISSCUSSION**

Figure 1. Document variable statistics

The findings in this study in general can be seen in Figure 1. Based on Figure 1 the variable that received the greatest response was line integral material related to hard work with a percentage of 14.3%. This happens because the formula for the line integral involves force multiplied by effort (J. Soebagyo et al., 2021) and based on the Guidelines for the Islamic Life of Muhammadiyah Citizens (PHIWM) in the muamalah aspect, point 4.3 explains that Muhammadiyah members must have an Islamic work ethic, one of which is hard work (Muhammadiyah, 2000). Furthermore, the category of fraternity was chosen by many respondents related to the vector field by 12.2%. This is because the vector field forms hordes of vectors with a certain pattern (J. Soebagyo et

al., 2021) and aspects of social life in PHIWM teach every Muslim to establish brotherhood (Muhammadiyah, 2000). The remaining percentages are spread into several categories, namely business, death, ihsan and so on.

In particular, from the material of vector fields, line integrals and vectors related to the categorization that appears in this study, several categories were found. First, there are three categories of vector material as shown in Figure 2.
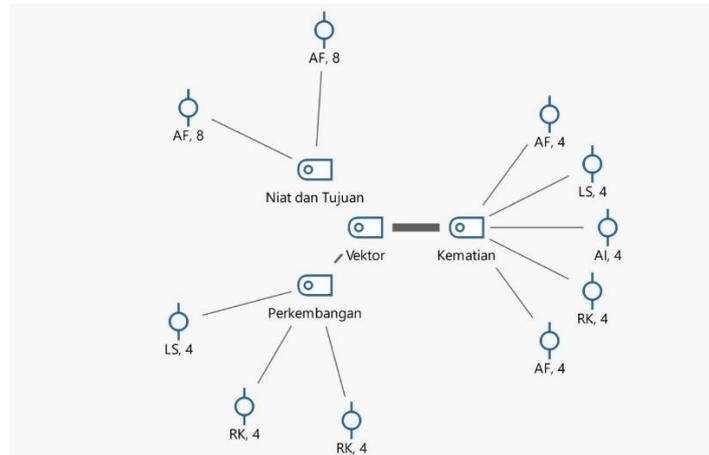

Figure 2. Diagram of vector relationships with categories

The findings from Figure 2 show that vector material is closely related to the category of death where five respondents stated that vectors have a beginning and an end just like human life. This happens because the principle of the vector is identical to the direction that has a goal and an end to a destination. Human birth is considered as the starting point of a vector, and then human death is considered as the end point or terminal of a vector. This finding is similar to the results of a study which states that vector fields can integrate human activities into risk metrics (Guo et al., 2022) although in a different field.

The beginning means that humans have the origin of creation and the end means that humans will face death. As the word of Allah SWT, "Say, "Indeed it is death that you flee from, then indeed death will meet you, then you will be returned to (Allah) who knows the unseen and the essential, then He will inform you. from what you've seen. do it." (Q.S. Jumu'ah: 8). Other emerging categories of vector material based on Figure 2 are development, intentions and goals. But the two categories do not have a thick line like the line between vector and death (Hayyu, 2018).
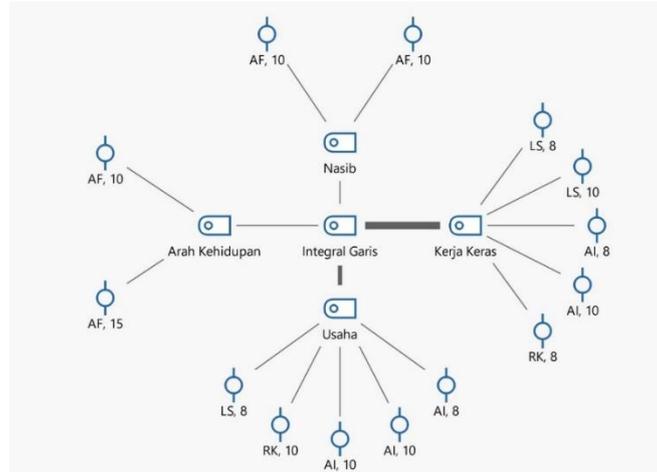
Figure 3. Diagram of line integral relationships with categories

Then in Figure 3, the results show that the line integral material has a strong relationship with the hard work category (Fransiskus Fran, 2019), where the five respondents voiced the same thing, namely maximum results are obtained from consistent hard work. If we connect it to hard work, it is very related, where when people do hard work they have to do it from the smallest things first and when they are disciplined to do it consistently, they will achieve maximum results from the effort they put in. Because the best humans who do hard work are strong and trustworthy humans, as Allah says in Surah Al-Qasas verses 26-27. In line integral material also appear other categories such as effort, direction of life, and fate. This finding is in line with the results of research on the application of line integrals to identify the hydrodynamic structure of eddies associated with flow through tidal inlets and coastal reservoirs/lagoons (Vouriot et al., 2019).

However, it can be seen in Figure 3 that these categories do not have a strong enough relationship with the material
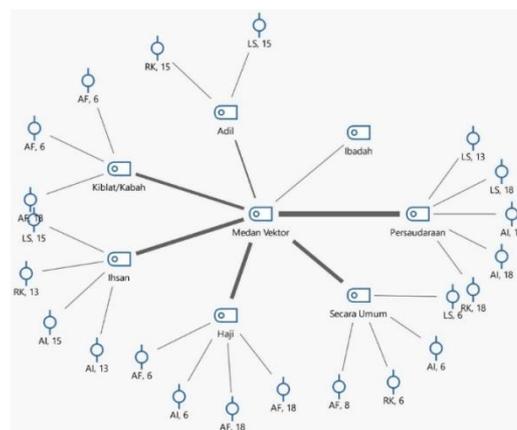

Figure 4. Diagram of the relationship of the vector field with categories

Furthermore, it can be seen from Figure 4 which states that the results voiced by respondents are related to the relationship between vector field material and existing

categories. It can be seen from the thickness of the connecting line, that the respondent believes that vector field material has a strong relationship with the fraternity category, as is the orthogonal moment function which is able to transform color into various variants (Yang et al., 2018). The following is a statement from one of the respondents regarding the relationship between vector fields and their categories.

In vector field material, if at the points (x, y, z) of an area in the space R a vector V is associated (x, y, z), then V is called a vector function of the position or function point vector (vector function point), and we state that the vector field V has been defined in the room. Now this we can relate to the value of brotherhood, if we have a group and there are other people outside our group, then it doesn't mean we have to stay away from even not knowing them, in fact we have to keep fraternity and consider him as part or our brother, like the area in room R which is associated with a vector V(x,y,z), even though it is not part of it but we still consider it defined in room R. As in Q.S. al-hujurat verse 10 which explains that every Muslim is a brother. Figure four also shows that vector field material is related to other categories such as Hajj, Ihsan, Qibla, and so on. But the lines connecting each category are thinner than fraternity.

▪ **CONCLUSION**

Research on the preparation of categorization of AIK values in the Multivariable Calculus course using content analysis has been successfully carried out. The results showed that there were three key categories of vector field, namely, death, hard work, and brotherhood. Vector material is closely related to death because the vector principle is identical to the beginning of life and the ultimate goal of a person. In integral material, it is closely related to hard work because the principle of line integral is in line with the work done by someone. In the vector field material, it is closely related to brotherhood because the principle of the vector field is grouped like a collection of people.

The results of this study can be used by Multivariable Calculus teachers to be integrated in their learning. Especially for Muhammadiyah campuses and other Islamic-based campuses in order to be able to implement Islamic and Muhammadiyah values in their learning. However, there are three other potential categories such as Hajj, Qibla, and Ihsan. This research is still limited to the number of respondents involved because the requirements are quite strict. It is hoped that further research can increase the number of respondents who meet the requirements to develop research.

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