

Talent Development Center Recommendation System Using Content-Based Filtering

Maysha Permata Putri, Benny Daniawan

Abstract— The development of digital technology has led to increased gadget usage among children. This condition highlights the need for efforts to divert children's attention toward more beneficial activities, one of which is talent development. However, limited information often becomes an obstacle in choosing the right place for talent development that suits an individual's needs and interests. This study aims to design a talent development center recommendation system by implementing the Content-Based Filtering (CBF) method, combined with the Term Frequency–Inverse Document Frequency (TF-IDF) algorithm to enhance the relevance of the recommendations by calculating the similarity level between talent development center descriptions based on keyword weights. This approach allows the system to provide more personalized recommendations without relying on other users data, especially in cases of minimal or unavailable data (cold-start). The testing conducted in this study, using 7 sample talent development centers, resulted in 5 recommendations with the top recommendation being Chic's Musik, which had the highest TF-IDF value of 1.9029, indicating the most suitable level of similarity between the description and user preferences. The system developed in this study has great potential in helping parents and individuals find suitable talent development centers more quickly, objectively, and according to their needs.

Index Terms— Content-Based Filtering, Recommendation System, TF-IDF, Talent Development

I. INTRODUCTION

Generation Z is the initials for a group of individuals who were born and grew up along with the hustle and bustle of technological developments, giving them superior skills and comfort in using technology [1], [2]. As they age, the internet and social media are part of everyday life, providing advantages while also creates conditions where these young generations cannot live their daily lives without gadgets, which serve as a gateway to the digital world [3], [4]. Parents often use gadgets to control their children's behavior, ensuring

they remain calm and well-behaved in public [5]. Although giving children gadgets is like a useful obligation to increasing the child's creativity and imagination, excessive use can create symptoms of addiction and make children lazy to do other things [6], [7]. Quoted from the article [8], The Indonesian Child Protection Commission (KPAI) stated that in Indonesia, 96% of children use gadgets, and 25.2% are children aged 5 to 9 years old.

One solution to minimize excessive gadget use in children is redirecting their focus to other, more enjoyable but productive activities, such as developing their talents. Talent is an ability or potential that someone has within themselves and has existed since birth, creating the ability to master a field without excessive effort more easily [9], [10]. Children will have a sense of happiness when they know their potential and will tend to keep achieving greater success, allowing them to gradually forget their addiction to gadgets [11], [12].

Talent development is certainly assisted by a good, comfortable environment that meets the child's needs. However, with so many choices, it can be difficult to find a suitable place for talent development without spending too much time and money. Therefore, a recommendation system is needed, one that is capable of providing relevant advice according to the seeker's preferences [13] in the form of information that is personalized according to the user's behavioral patterns [14]. Recommendation systems are also information filtering tools familiar in various digital media, such as movie recommendations on Netflix, Videos on YouTube, Products on e-commerce such as Shopee, or songs on Spotify. The purpose of the recommendation system includes improving the user experience and helping to find needs more easily [15], [16].

Several approaches are most often applied in recommendation systems, such as the Content-Based Filtering (CBF) method, the Collaborative Filtering (CF) method, and the Hybrid Recommendation method. Collaborative Filtering method in its use provides recommendations based on similarities owned by users [17], for example in the CF User-Based approach, if first user and second user have similar preferences in their historical data, the CF method will recommend the same thing in the future for both users [18]. Another CF approach is Item-Based, which analyzes similarities

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Maysha Permata Putri is Faculty of Science and Technology Buddhi Dharma University, Tangerang, Indonesia (email: mayshapermataputri7@gmail.com)

Benny Daniawan is Faculty of Science and Technology Buddhi Dharma University, Tangerang, Indonesia (email: b3n2y.miracle@gmail.com)

based on items or objects from user behavior [19], [20]. On the other hand, the Hybrid Recommendation method is a method that combines more than one recommendation system approach to produce novelty and increase accuracy values [21].

Several previous studies, such as the one conducted by Larasati and Februariyanti [22], explained that the CBF method is appropriate for comparing products based only on title or description parameters. With the CBF method result of 0.7195, the study is still limited by its reliance on descriptions without taking into account the complex preferences of makeup users. Other studies conducted by Dermawan and Daniawan [23], used the CBF method on the music entertainment service recommendation system, helps music experts promote their services and people find musicians to fill certain events. Although the system provide recommendations with an acceptance rate of 56.1% based on the TAM evaluation, this study tends to emphasize system acceptance rather than the quality of the recommendations. Next, there is a study using the CBF method equipped with the TF-IDF algorithm was conducted by Putri, Muchayan, and Kamisutara [24], the built pen recommendation system can produce an accuracy rate of 96.5% from 100 with the highest TF-IDF calculation value of 13.854. Despite its high accuracy, the study focused too much on a single object, so it did not describe the performance of CBF with a variety of data.

There is also a study that employs a hybrid method, combining CBF and CF methods, which was conducted by Faurina and Sitanggang [25], where the system provides recommendations for tourist destinations in Bali based on the preferences and interests of tourists, resulting in improved recommendation performance with an RMSE of 0.2427. However, despite the positive outcome, the study placed too much emphasis on processing ratings and preferences, and it has not been evaluated in other destinations that do not have a similar structure. Further research was conducted by Walek and Fojtik [26], focusing on the development of a movie recommendation system using a hybrid method that combines CBF and CF. In this study, CF will adjust the user's rating with existing interests and genres, while the CBF was used for search filters. The results obtained show that system performance in this study is good with the hybrid method compared to other methods from the comparison test. However, because it focuses on the entertainment field, the recommendation results tend to be biased and cannot be applied to other fields.

Based on the many studies above, it can be concluded that the implementation of CBF and TF-IDF has succeeded in providing recommendations by adjusting descriptions and keywords, while the hybrid method improves accuracy by involving a lot of information. However, a gap still remains, since the CBF method has not yet been specifically applied to talent development center recommendations, which has different characteristics from physical products, entertainment, or tourism destinations, this study aims to fill that gap by

developing a CBF-based recommendation system for talent development center by utilizing seekers preferences and center descriptions as the main parameters. The complete evaluation of Technology Acceptance Model has been addressed and published in a separate companion study [27] to ensure a focused scientific contribution and avoid redundant publication.

II. METHODS

The content-based filtering method was chosen in this study because the developed system bases its recommendations on keywords entered by seekers to recommend objects that match their preferences, without interference from other seekers [28]. This approach fits systems that do not have user rating data, allowing more personal recommendations, equipped with the Terms Frequency Inverse Document Frequency (TF-IDF) algorithm to measure keyword and parameter similarity. TF-IDF consists of two components: Terms Frequency (TF), which is used to calculate the occurrence of each word in the keyword, and Inverse Document Frequency (IDF), which measures the relationship of words to each other.

The dataset used in this study was obtained through observations and interviews conducted at several talent-development centers located in the city of Tangerang. The total dataset collected consist of 33 talent development centers (center ID, center name, and center description). The main focus of this study was to test the CBF method, so 7 centers were selected for step-by-step simulation calculations to illustrate the mechanism of keyword processing and similarity calculation within the CBF formula. The system was developed using Intel Core i5 laptop hardware and Visual Studio Code software.

The recommendation process with the CBF method in this study is carried out through the following stages:

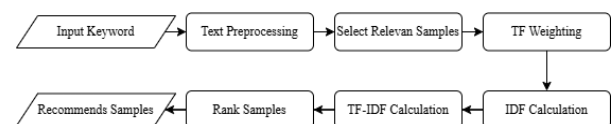


Fig. 1. CBF Recommendation Process Flowchart

1. The seeker enters the desired keyword into the search field.
2. The system will start the text preprocessing process, where raw data selection is carried out from the parameters involved in the calculation. This stage consists of:
 - a. Tokenization is the process of separating each word that makes up each sentence or document, with commas or quotation marks, as well as removing duplicate words.
 - b. Stopword Removal removes each word that is considered less important or does not represent the meaning of the sentence or document, such as “which”, “or”, and so on.
3. The text preprocessing process will first start with the keyword parameters, followed by the system's selection of data samples through a database

whose descriptions (parameters) are related to the searched keywords.

4. TF-IDF calculation to calculate the similarity weight of each data sample with the keywords entered by the searcher. Starting from TF weighting and ending with the IDF calculation and TF-IDF calculation.
5. TF weighting is done by giving a value of 1 to each word in the description containing the keyword. The formula used for this TF weighting can be seen in Equation (1).

$$TF(T_{x,y}) = \left(\frac{N(T_x, D_y)}{N(D_y)} \right) \tag{1}$$

Explanation:

T_x : Keyword x.

D_y : Document or sample y.

$T_{x,y}$: Total number of times the keyword appears in each sample.

$N(T_x, D_y)$: Total number of times the word T_x appears in the D_y sample.

$N(D_y)$: Total number of keyword in sample D_y .

6. The IDF calculation is obtained from the logarithm of the total number of samples divided by the number of keywords that appear in each sample. The formula used in this IDF calculation can be seen in Equation (2).

$$IDF(T_x) = \log \left(\frac{N(D)}{N(D, T_x)} \right) \tag{2}$$

Explanation :

$N(D)$: Total number of samples.

$N(D, T_x)$: Total number of keywords that appear in each sample.

7. After the TF and IDF values have been obtained, the process continues to the final calculation, that is calculating the TF-IDF value. The TF-IDF value is obtained by multiplying the TF value by the IDF value. The following formula is used can be seen in Equation (3).

$$TF - IDF(T_{x,y}) = TF(T_{x,y}) \times IDF(T_x) \tag{3}$$

8. Lastly, sort each sample from the largest to the smallest total TF-IDF as a recommendation for the searcher.

There is potential for bias in the system, such as differences in description structure, keyword suitability depending on the seeker, and a lack of consideration for other seeker preferences, which can result in overly narrow recommendations.

III. RESULT AND DISCUSSION

The Content-Based Filtering method in the talent development center recommendation system begins with the entry of keywords by the center seeker (searcher). The system provides 7 samples shown in Table 1, with the keywords: "Basic music and vocal courses for elementary school children aged 8 years"

Table 1. Sample Talent Development Centers

Center ID	Center Name	Center Description
1	Reyal Musik Studio	Music lessons for children starting from the age of 10. We

		provide programs for simple music instruments such as piano, guitar, and drums, located in East Jakarta.
2	Chic's Musik	Basic courses for children interested in the art of music, offering vocal and music instrument programs for 3 meetings a week. Free registration fee especially in May, for elementary and junior high school students.
3	Jellyfish Language Academy	Learn Japanese only at Jellyfish Language Academy with a curriculum directly from Japan. Located in Gading Serpong with the best teachers.
4	KBL Performing Arts	Art courses with three main programs, namely Vocal, Music, and Stage Art. Special discounts in August for children aged 8-10 years. We offer teaching from basic to proficient.
5	Canzona Music School	Teaching music arts for babies and children. Covers the basics of playing guitar, piano, and others at the age of 0 to 12 years. Located in West Jakarta.
6	Purwa Caraka Musik Studio	Music and vocal courses, consisting of vocal programs for children, teenagers, and adults. Basic piano, guitar, drum, trumpet, and other programs are also available.
7	Timedoor Academy	Technology education institution that offers courses in programming and digital literacy. Using English and Japanese adapted curriculum. Located in Paku Jaya, North Serpong.

a. Text Preprocessing

The first stage starts with text preprocessing for the keywords entered by the searcher, the process is shown in Table 2.

Table 2. Text Preprocessing Keywords

Process	Before	After
Tokenization Process	Basic music and vocal courses for elementary school children aged 8 years	"basic", "music", "and", "vocal", "courses", "for", "elementary", "school", "children", "aged", "8", "years"
Stopword Removal Process	"basic", "music", "and", "vocal", "courses", "for", "elementary", "school", "children", "aged", "8", "years"	"basic", "music", "vocal", "courses", "elementary", "school", "children", "age", "8", "year"

After the keywords went through the text preprocessing process, it was found that from the 7 available samples, only 5 samples had descriptions containing the same words as the keywords. Samples with appropriate descriptions will go through the text preprocessing process, shown in Table 3.

Table 3. Text Preprocessing Data Search Results

Center ID	Before	After
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1	Music lessons for children starting from the age of 10. We provide programs for simple music instruments such as piano, guitar, and drums, located in East Jakarta.	“music”, “lesson”, “children”, “starting”, “age”, “10”, “we”, “provide”, “program”, “simple”, “music”, “instrument”, “piano”, “guitar”, “drum”, “located”, “east”, “jakarta”
2	Basic courses for children interested in the art of music, offering vocal and musical instrument programs for 3 meetings a week. Free registration fee especially in May, for elementary and junior high school students.	“basic”, “courses”, “children”, “interested”, “art”, “music”, “offering”, “vocal”, “music”, “instrument”, “program”, “3”, “meeting”, “week”, “free”, “registration”, “fee”, “especially”, “may”, “elementary”, “junior”, “high”, “school”, “student”
4	Art courses with three main programs, namely Vocal, Music, and Stage Art. Special discounts in August for children aged 8-10 years. We offer teaching from basic to proficient.	“art”, “courses”, “three”, “main”, “program”, “namely”, “vocal”, “music”, “stage”, “art”, “special”, “discount”, “august”, “children”, “age”, “8”, “10”, “year”, “offer”, “teaching”, “basic”, “proficient”
5	Teaching music arts for babies and children. Covers the basics of playing guitar, piano, and others at the age of 0 to 12 years. Located in West Jakarta.	“teaching”, “music”, “art”, “babies”, “children”, “cover”, “basic”, “playing”, “guitar”, “piano”, “other”, “age”, “0”, “12”, “year”, “located”, “west”, “jakarta”
6	Music and vocal courses, consisting of vocal programs for children, teenagers, and adults. Basic piano, guitar, drum, trumpet, and other programs are also available.	“music”, “vocal”, “courses”, “consisting”, “vocal”, “program”, “children”, “teenager”, “adult”, “basic”, “piano”, “guitar”, “drum”, “trumpet”, “other”, “program”, “available”

b. TF-IDF Calculation

First, TF weighting is carried out by giving the number 1 to each word containing the keyword in the sample description, according to Equation (1).

Table 4. TF Weighting

ID	TF(Tx)									
	B	M	V	C	E	S	C2	A	8	Y
1	-	1	-	-	-	-	1	1	-	-
2	1	1	1	1	1	1	1	1	-	-
4	1	1	1	1	-	-	1	1	1	1
5	1	1	-	-	-	-	1	1	-	1
6	1	1	1	1	-	-	1	-	-	-

The keywords used consist of ten words from the keyword text preprocessing process. The keywords include: basic = B, music = M, vocal = V, courses = C, elementary = E, school = S, children = C2, age = A, 8 = 8, and year = Y.

In Table 3 it can be seen that the TF weighting is complete, continuing to the IDF calculation stage with the formula in equation (2).

Table 5. IDF Calculation

Tx	N(D)					N(D, Tx)	N(D, Tx) / N(D, Tx)	IDF (Tx)	
	1	2	4	5	6				
B	-	1	1	1	1	5	4	1.25	0.0969
M	1	1	1	1	1	5	5	1.00	0
V	-	1	1	-	1	5	3	1.60	0.2041
C	-	1	1	-	1	5	3	1.60	0.2041
E	-	1	-	-	-	5	1	5.00	0.6989
S	-	1	-	-	-	5	1	5.00	0.6989
C2	1	1	1	1	1	5	5	1.00	0

A	1	-	1	1	-	5	3	1.60	0.2041
8	-	-	1	-	-	5	1	5.00	0.6989
Y	-	-	1	1	-	5	2	2.50	0.3979

After all the values needed for the TF-IDF calculation are obtained in Table 5, the data is then grouped according to the TF-IDF calculation formula attached to Equation (3), shown in Table 6.

Table 6. TF-IDF Calculation

Data	1	2	4	5	6
0	0	0.0969	0.0969	0.0969	0.0969
0	0	0	0	0	0
0	0.2041	0.2041	0	0	0.2041
0	0.2041	0.2041	0	0	0.2041
0	0.6989	0	0	0	0
0	0.6989	0	0	0	0
0	0	0	0	0	0
0.2041	0	0.2041	0.2041	0	0
0	0	0.6989	0	0	0
0	0	0.3979	0.3979	0	0
Total	0.2041	1.9029	1.8060	0.6989	0.5051

c. Recommendation Order Based on the Largest TF-IDF Value

Table 7. Recommendation Results

Center ID	Center Name	Total TF-IDF	Recommendation Rank
2	Chic’s Musik	1.9029	1
4	KBL Performing Arts	1.8060	2
5	Canzona Music School	0.6989	3
6	Purwa Caraka Musik Studio	0.5051	4
1	Reyal Musik Studio	0.2041	5

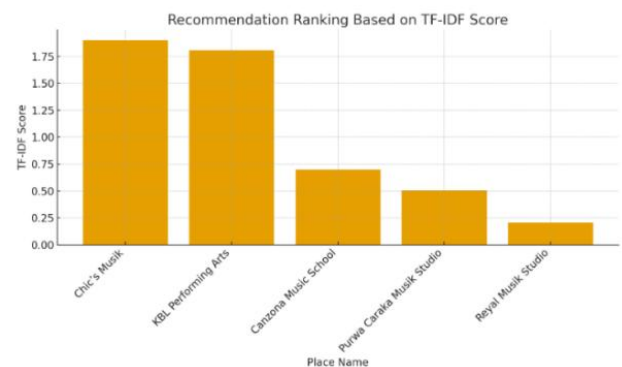


Fig. 2. Recommendation Results

Table 7 shows the results of the TF-IDF calculation. Based on the results, the CBF recommendation system will recommend Chic’s Musik first in the search results, with a total TF-IDF of 1.9029.

Based on the CBF recommendation process, the system is able to generate recommendations results according to the degree of similarity between the seeker’s keywords and the descriptions of each talent-development center. A higher TF-IDF value indicates that the description contains terms that are more relevant to the keywords entered by the seeker, leading to the conclusion that descriptions which are more

varied, specific descriptions that include frequently searched words related to activities and facilities will yield higher results. In this study, Chic's Musik obtained the highest value because the keywords found in its description were the most consistent with the seeker's preferences, showing that CBF can effectively identify relevance through textual processing [29].

Compared to other recommendation methods, such as Collaborative Filtering, CBF has an advantage in handling cold-start conditions because it focuses only on the main user, without involving other users in its application, making it very suitable for new users who have not interacted much with the system [30]. The CBF method is well suited for recommendation systems that are entirely new and do not yet have a large amount of recommendation data. However, the lack of diverse references from user interactions also creates limitations in the system ability to provide broader recommendations, meaning that users may only receive recommendations that are the same or similar to what they have obtained before. In addition, the limited dataset in this study means that the results cannot yet be considered strong evidence of performance when compared to the real-world population of talent-development centers. In wider applications, differences in the wording of each center's description will pose a challenge for the CBF method, which only evaluates keywords and descriptions without understanding their overall meaning. Beyond the quantitative results of the recommendation process, the system has significant qualitatively potential to help seekers find talent-development center without needing to visit each location or manually check every piece of information. This is supported by the results of system acceptance testing using TAM, which indicate high levels of acceptance across all key metrics, particularly the Behavioral Intention to Use (BITU) variable, thereby reinforcing the application and implementation value of the CBF method used in this study [27].

IV. CONCLUSIONS

This study shows that the implementation of the Content-Based Filtering method in a talent development recommendation system can provide relevant recommendations based on seeker preferences, where the CBF method produces 5 recommendations from 7 available data samples, with the top recommendation being Chic's Musik, which had the highest TF-IDF value of 1.9029. Through the use of keywords and center descriptions as parameters in the TF-IDF algorithm calculation, the CBF method is able to produce measurable compatibility between seeker interests and center descriptions, confirming that CBF is effective even though the system has certain data limitations. Furthermore, acceptance testing using the TAM method reported in a separate study confirms that the system was positively accepted by end users, particularly in terms of their intention to use and attitudes toward using. Overall, this study contributes to the development of systems in the field of education and talent development, particularly in providing a

structured, measurable, and easy to implement approach to help seekers find the talent development center that best match their needs.

Although the system's performance can be considered good, the relatively small number of samples limits the recommendation capabilities, and the complete dependence on keywords has the potential to cause bias if seekers enter keywords that are too general or ambiguous. Further research is expected that the system can be further developed, in terms of methods it can be equipped with a combination of CBF and CF methods, so that a more accurate and maximum Recommendation System is created with additional intervention from other seekers, considering that the CF method utilizes more preferences and behavior from other seekers for future recommendations, equipped with rating and review functions to further increase the certainty of selection from each seeker.

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- Maysha Permata Putri** pursued a Bachelor's degree (S1) in Information Systems at Buddhi Dharma University, Tangerang in 2021 and graduated in 2025. During her time as a student, the author gained a lot of valuable experiences, both academic and non-academic. One of them was getting an academic achievement in the form of a scholarship for four semesters with a GPA of 3.97, the author also actively participated in several integrated researches with lecturers. She can be contacted at email: mayshapermataputri7@gmail.com
- Benny Daniawan** pursued a Master's degree (S2) in Information Systems at Budi Luhur University Jakarta in 2014 and graduated in 2016. Since 2017, the author has been working as a lecturer in the Information Systems Study Program at Buddhi Dharma University Tangerang. His research interests include multicriteria decision-making (MCDM) and the technology acceptance model (TAM). He can be contacted at email: b3n2y.miracle@gmail.com