

## Developing Specialization Model Applications for High School Students

(Pengembangan Aplikasi Model Peminatan untuk Siswa Sekolah Menengah Atas)

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**Abstract:** This study aims to produce a model application of specialization for the majors of high school students. The research method used is the Borg and Gall development research method. The research procedure was carried out by conducting a literature review and preliminary study, planning, developing, validating, revising, testing on research subjects, revising, and finalizing and socializing the application specialization model. The research instrument used is a rating scale. Data analysis was carried out by averaging expert judgments on applying the specialization model that had been developed. In addition, data were also obtained from the results of student interest. The expert test results showed that the application of the specialization model for the majors of high school students that was developed was feasible to be used to provide recommendations for students' specialization. Data from students when using the specialization model is grouped into two types of data, namely appropriate and inappropriate. The results of the trial using the specialization model by students showed that 97 percent of the subjects stated that the conclusions of the specialization model were in accordance with their interests.

**Keywords:** application of the specialization model; career; guidance and counseling; individual-planning

**Abstrak:** Penelitian ini bertujuan menghasilkan aplikasi model peminatan untuk penjurusan siswa sekolah menengah atas. Metode penelitian yang digunakan adalah metode penelitian pengembangan Borg dan Gall. Prosedur penelitian yang dilakukan adalah melakukan kajian pustaka dan studi pendahuluan, perencanaan, pengembangan, validasi, revisi, uji coba kepada subjek penelitian, revisi, dan finalisasi serta sosialisasi aplikasi model peminatan. Instrumen penelitian yang digunakan adalah skala penilaian. Analisis data dilakukan dengan merata-rata penilaian ahli terhadap aplikasi model peminatan yang telah dikembangkan. Selain itu, data juga diperoleh dari hasil peminatan siswa. Hasil dari uji ahli menunjukkan bahwa aplikasi model peminatan untuk penjurusan siswa sekolah menengah atas yang dikembangkan, layak digunakan untuk memberi rekomendasi peminatan siswa. Data dari siswa saat menggunakan aplikasi model peminatan dikelompokkan menjadi dua jenis data, yaitu sesuai dan tidak sesuai. Hasil dari uji coba penggunaan aplikasi model peminatan oleh siswa menunjukkan bahwa 97 persen subjek menyatakan kesimpulan dari aplikasi model peminatan sesuai dengan minat mereka.

**Kata kunci:** aplikasi model peminatan; karier; bimbingan dan konseling; perencanaan-individual

## INTRODUCTION

One of the goals of guidance and counseling in schools is to help students have career stability (Gysbers & Henderson, 2014; Siddiky & Akter, 2021). The indicator of this goal is that students are in the right major. In fact, until now, the problem of wrong majors is still often found (Khofifah et al., 2017). On the other hand, many facilities can be used by school counselors in providing specialization services and individual planning aimed at understanding students, such as intelligence tests, interest aptitude tests, to career interest tests (Riasec) (Hartono et al., 2016; Utama et al., 2018; Zamroni et al., 2014).

From a survey conducted in 10 classes at the university from five different majors, it was found that three to five students admitted that they were uncomfortable in class because they felt they were in the wrong major. One of the causes of wrong majors experienced by students is the background of one major at the high school level. Some of the wrong major results are: causes lazy behavior and lacks the motivation to excel compared to those who study in the majors that match their interests. In addition, the wrong major can also affect academic factors and the psychological condition of students (Köse, 2019; Renninger & Hidi, 2015). Anxiety, low motivation, stress, and avoiding classmates are examples of problems experienced by students in the wrong major (Susilowati, 2008).

One of the obstacles school counselors face in helping specializations is that it is difficult to obtain information about students from previous schools because there is no track record (Cahyono, 2019). The comparison between the number of school counselors and the disproportionate number of students causes school counselors to take a long time to organize students' data, especially if it is done manually (Kamaruzzaman, 2017). In fact, these data are the basis for channeling students' interests to high school or work.

The application of the specialization model is useful to help school counselors organize student specialization services, including providing information, collecting data, adjusting data, and placing/interesting (Hidayati, 2018). By using the media in the form of a specialization model application, school counselors can obtain a summary of the condition of each student based on academic data and psychological test results more efficiently. This is in line with research that has confirmed that the use of media in guidance and counseling is very effective in helping school counselors provide services to students (Dewanti & Sujarwo, 2021; Muti, 2021; Septyani et al., 2021). Accuracy in processing and summarizing learning outcomes and psychological test results will help school counselors provide more appropriate recommendations for student specialization so that students can determine careers more precisely. Good planning of specialization and self-development will affect student's career satisfaction (Putri et al., 2019).

In Indonesia, research on specialization is still rarely done. One of the research on the development of a specialization model was carried out by Makrifah (2014), namely developing a package of specialization in classical guidance services for junior high school students. In contrast to the research, the application of the specialization model that will be developed in this study is the high school specialization which is intended for high school students. Other research by Marlina et al., (2015), has developed an inventory of interests. Unfortunately, the inventory is only used specifically for vocational high school students majoring in business management. Other studies that have been carried out on the specialization of high school students so far aim to describe the condition of the specialization of high school students (Fartindyah & Subiyanto, 2014; Kursi, 2016; Lailatul Makrifah, 2014; Marlina et al., 2015; Naparin, 2016). The development of application development models for high school specialization to enter high school is still rarely developed.

This study aims to develop a model application for high school students' interest. The product resulting from this research is a Microsoft Excel-based application model for high school students, hoping that school counselors can use it easily without the need to install additional applications or have an internet connection. The result of developing this specialization model application is to avoid obstacles in managing student data so that students can appropriately determine the selection of high school.

## METHOD

A research & development informed by Borg & Gall was employed in the study. This research method was chosen because it has practical research procedures and is in accordance with the research objectives, namely developing products in specialization model applications. The research was conducted for four months, from June to October 2020.

### Research Sites

The location of the research was carried out at Muhammadiyah 2 Yogyakarta junior high school, which consisted of 30 ninth-grade students who were going to continue their education at senior high school.

### Research subject

This study has two types of subjects, namely expert test subjects and product test subjects. Expert test subjects are psychologists and school counselors. The criteria for the expert test subjects are school counselors who accompany ninth-grade students and have work experience as school counselors for at least three years. The criteria for psychologists to become experts are to have a specific interest in psychological tests and psychological instruments. The product trial subjects in this study were ninth grade junior high school students.

### Data Collection Instruments

The main instrument used is a rating scale to collect an assessment of whether the application of the developed specialization model is appropriate. The rating scale uses a Likert scale from a range of 1-5. A score of 1 indicates a very bad score, and a score of 5 indicates a very good score. The assessment criteria are the feasibility of software engineering used, the design of guidance and counseling services used, and aspects of visual communication.

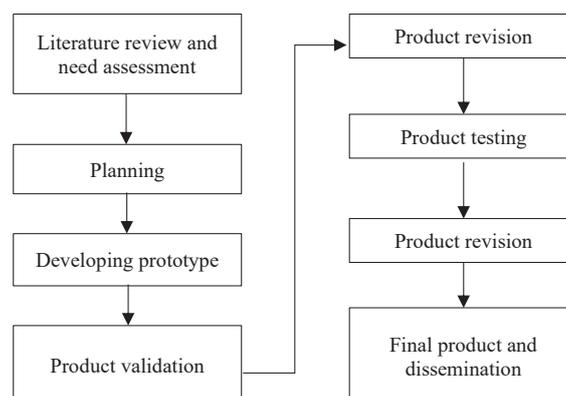
Another instrument used is a documentary study. Documentary studies are used when testing the specialization model. The documentary study used contains data on student achievement results from first semester to fifth semester and psychological test data summarized from the results of the specialization model. Interviews are also used as a data collection instrument to reveal qualitative data.

### Data Analysis

The research data were analyzed using quantitative and qualitative data analysis methods. Quantitative data analysis was used to analyze the data from expert test results and analyze the suitability of the use of models obtained from the assessment scale and documentary studies. Meanwhile, qualitative data analysis was used to analyze expert suggestions and comments about the feasibility of the model.

### Research procedure

Overall, the research procedures carried out are presented in Figure 1.



**Figure 1. Research Procedures for Development of Specialization Model Applications**

### ***Literature Review and Needs Analysis***

At the literature review and needs analysis stage, preliminary research is carried out, and the collection of information or data needed for product development. Some of the supporting literature as the basis for the development of the model application used is the Specialization of High School and Vocational High School Students, the Interest and Cross Interest Model, the Student Specialization component assessment module, as well as other published Specialization Guidelines.

### ***Planning***

At the planning stage, the researcher defines the concept and formulates the objectives of developing a specialization model application for high school students. At this stage, the researcher also determines the research subjects and instruments for expert testing and product testing.

### ***Early Development***

In the initial product development stage, the activity begins with collecting data for ninth grade students of Muhammadiyah 2 Yogyakarta junior high school. The data collected is then summarized and recommendations are made for the selection of student specialization. In accordance with the latest curriculum for students in high school, students begin to be majored in tenth grade with a choice of study programs in Natural Sciences, Social Sciences and Language and Culture. Summaries and recommendations based on student data are used to fill out the application form for the specialization model that will be developed. The form developed consists of three components, namely: (1) worksheets containing data on learning achievement or report cards along with a questionnaire on the wishes of students and parents regarding the choice of schools and majors in high school, (2) worksheets containing data on psychological test results, (3) worksheets are containing individual reports as recommendation material from the feeder school (junior high school) to the receiving school (high school). This report is also for initial data on guidance and counseling services as a whole while studying in high school.

### ***Product Validation***

At the product validation stage, research activities are focused on testing the validity of the products that have been developed in the previous stage. Product validation was carried out to two experts, namely school counselors and psychologists from the Technical Implementation Unit for Guidance and Counseling Services, Universitas Negeri Yogyakarta. The psychologist is also a lecturer in the Psychology Study Program and a counselor at Universitas Negeri Yogyakarta who has expertise as a psychological tester and psychologist, so he is experienced in administering psychological tests and communicating test results for guidance and counseling services in schools.

### ***Product Revision***

At the product revision stage, researchers made improvements to the application of the specialization model based on the results of expert validation so that the product was more suitable for use. In addition, the revision also aims to make filling out specialization data consisting of learning achievement data, non-test data and psychological test data more effectively.

### ***Product Trial***

The next stage is product testing. The first product trial activity is the main field test. The activity was carried out at Muhammadiyah 2 Yogyakarta junior high school. Product trials were carried out by collecting learning achievement data, academic achievement data, data on the choice of parents and students' interests, and data on psychological test results. Furthermore, the researcher uses the application of the specialization model to draw conclusions about the specialization recommendations based on these data. Recommendations are submitted to the school counselor for later assessment. The assessment of the specialization model is emphasized on the aspect of whether it is in accordance with the needs at school, whether it can facilitate the needs of students and parents for the continuation of students' studies to high school with a choice of study programs according to general abilities, special

abilities, interest data, report card achievement data, data academic and non-academic achievements as well as data on the choices of parents and students. In addition, the model trial activity also pays attention to the suitability of the recommendations with the student's condition obtained from the documentary study of the student's specialization.

After conducting field trials, the next step is to conduct operational field tests. The activity carried out provides test services to ninth grade students at Muhammadiyah 2 Yogyakarta junior high school. The results of individual reports are used to obtain input from field tests so as to obtain a final product that can be used for specialization activities as needed in schools. From the input at the operational field test stage, the application of the specialization model was revised into the final product. The last stage after the revision was to socialize the application of the specialization model.

## **RESULTS**

From a series of research procedures carried out, it is known that the application of the developed specialization model meets the eligibility criteria. This is evidenced by the average score given by experts in all aspects, namely 4.4. In addition, at the product trial stage, it was also known that 97% of students stated that the recommendation for the application of the specialization model was correct. This means that the developed application can be used as an alternative model of specialization for students who will continue their studies to high school.

### **Phase 1 Research Results (Library Study and Needs Analysis)**

The results of the research in the first stage, namely conducting a literature review and needs analysis, found the results of a literature review, all models using non-test instruments such as questionnaires and forms of learning achievement analysis or academic achievement scores that can be seen in the report cards of each student.

While needs analysis in the field, especially in high school, specialization usually uses: (1) non-test instruments such as interest questionnaires, (2) student and parent questionnaires, (3) report cards or learning achievement scores, and (4) psychological tests. Based on information from school counselors, the use of specialization still relies on non-test instruments and not many use psychological tests because not all schools provide a budget for test services for students in junior high school for specialization activities. Meanwhile, based on the results of interviews from high school counselors, it is known that students who enter high school are not facilitated with complete specialization recommendations by junior high school counselors.

### **Planning Stage Results**

The result of the planning stage is the formulation of development goals that are focused on students' interest when entering high school. In addition, the research subject has also been determined, namely ninth grade students of Muhammadiyah 2 Yogyakarta junior high school. At this stage, a design for the development of a specialization model is also determined that will use information in the form of academic achievement, results from the use of non-test instruments, and results from psychological tests.

The information content of the interest model application contains the above components. Academic achievement results were obtained from the use of non-test instruments and results from psychological tests. While the model format is made using a spreadsheet program, namely Microsoft Excel. This computer-based specialization model using Microsoft Excel will later become a prototype model that can be developed better by using other Android-based or internet-based programs for further development.

### **Results of Early Product Development Stage**

The result of this stage is a product prototype consisting of a learning achievement data worksheet, a psychological test data worksheet, and an individual report worksheet. The components of the learning achievement data worksheet are presented in Table 1, while the contents of the psychological test data worksheet are presented in Table 2. Figure 2 shows the components in the individual report worksheets.

**Table 1. Worksheet Contents Regarding Student's Achievement**

Aspect	Content
Academic report (average score 1st – 5th semester)	Mathematic
	Natural science
	Social science
	Indonesian Language
	English Literature
	Islamic Education
Student's achievement	Academic
	Non-academic
Recomendation	Students
	Parents

**Table 2. Psychological Test Result**

Aspect	Sub Aspect	
Psychological Test	IQ	Intelligence
		Verbal
		Numerical
	Aptitude	Scholastic
		P understanding
		Concentiousness
Interest	Choice of interest 1	
	Choice of interest 2	
	Choice of interest 3	

### Model Validation Stage Results

At this stage, the average assessment given by psychologists and counselors to the application of the specialization model and some input from the two experts is obtained. The average assessment of the specialization model by school counselor is presented in Table 3. While the evaluation and recommendations given by psychologists are presented in Table 4 and Table 5.

Table 5 shows recommendations from school counselors and psychologists. Totally, there are three recommendations: to collect data about students' interests ought to use a different form, individual reports and recommendations should be more straightforward but cover all information needed, the academic data and students' choices can be merged into one report. The recommendations will be used as the basis for revision.

**Table 3. School's Counselor Evaluation**

Evaluation Aspect	Score	Evaluation Result
Software engineering	4.33	Feasible
Guidance and counselling service	4.75	Feasible
Visual communication	4.00	Feasible

**Table 4. Psychologist's Evaluation**

Evaluation Aspect	Score	Evaluation Result
Software engineering	4.78	Feasible
Guidance and counselling service	4.25	Feasible
Visual communication	4.29	Feasible

<b>A GENERAL ABILITY</b>													
A.1	Intelligence												
<b>B SPECIAL ABILITY</b>													
B.1	<b>Understanding</b> (the ability to understand texts)												
B.2	<b>Verbal</b> (The ability to show communication and language skill)												
B.3	<b>Numeric</b> (The ability to works with number)												
B.4	<b>Scholastic</b> (The ability in accademic setting)												
B.5	<b>Conscientiousnes</b> (the ability to works fast and conscientious)												
<b>D APTITUDES</b>													
<table border="1"> <caption>Student's aptitudes profile</caption> <thead> <tr> <th>Aptitude Category</th> <th>Score</th> </tr> </thead> <tbody> <tr> <td>Understanding (The ability to understand reading material)</td> <td>25</td> </tr> <tr> <td>Verbal (The ability to work use language effectively)</td> <td>20</td> </tr> <tr> <td>Numerical (The ability process numerical data)</td> <td>10</td> </tr> <tr> <td>Scholastic (Academic ability)</td> <td>10</td> </tr> <tr> <td>Conscientiousness (the ability to works fast and conscientious)</td> <td>5</td> </tr> </tbody> </table>		Aptitude Category	Score	Understanding (The ability to understand reading material)	25	Verbal (The ability to work use language effectively)	20	Numerical (The ability process numerical data)	10	Scholastic (Academic ability)	10	Conscientiousness (the ability to works fast and conscientious)	5
Aptitude Category	Score												
Understanding (The ability to understand reading material)	25												
Verbal (The ability to work use language effectively)	20												
Numerical (The ability process numerical data)	10												
Scholastic (Academic ability)	10												
Conscientiousness (the ability to works fast and conscientious)	5												
<b>C INTEREST</b>													
1	OUT Outdoor												
2	SS Social Service												
3	MUS Musical												
<b>APTITUDES CHOICES</b>													
1	Outdoor												
2	Mechanical												
3	Computational												
4	Scientific												
5	Personal Contact												
6	Aesthetic												
7	Literary												
8	Musical												
9	Social Service												
10	Clerical												
11	Practical												
12	Medical												
<b>D Preferences suggestion</b>													
Example: Based on the general ability, unique ability, and aptitudes, the student can enroll in social science.													
<b>Description :</b>													
The Intelligence test is the test that measures the ability of an individual to think and problems solving.													
The result of the intelligence test categorized into 5:													
Deficient	: Slow Learner , IQ < 80												
Below average	: Below Average, 80 ≤ IQ <90												
Average	: Average, 90 ≤ IQ ≤110												
High	: Above Average or Bright 110 < IQ ≤ 120												
Excellent	: Superior 120 < IQ												
The preferences suggestion in this application is only based on an intelligence test. The teacher and parent have to consider the student's academic report													

Figure 2. Individual Worksheet

Table 5. Recommendations from School's Counselor and Psychologist

No.	Recommendation	
	School's counsellor	Psychologist
1.	To collect data about students' interests ought to use a different form.	Individual reports and recommendations should be more straightforward but cover all information needed.
2.	-	The academic data and students' choices can be merged into one report.



achievement students, both academic and non-academic, as well as the choices of students and parents, recommendations for specialization, and the person in charge of the recommendation usually contains the signatures of the principal and school counselor. The contents of the individual report can be seen in Figure 5.

RECOMMENDATION		NO		
Name	:			
Gender	:			
Grade/Student's n	:			
School	:			
Address	:			
Aspect	sub-Aspect	Result	Description	
Accademic report froms 1st semester until 5th semester	Mathematic			
	Natural Science			
	Social Science			
	Indonesian language			
	English literature			
	Islamic study			
Pscychological Test	IQ	Intelligence		
	Bakat	Verbal		The ability to communicate, to write using langu
		Numerical		The ability to processing numerical data
		Scolastic		Accademic ability
		Understanding		The ability to understand information
	Concentiousness		The ability to work conciousness	
	Interest choice 1	OUT	Outdoor (Kind of career that require outdoor activities)	
	Interest choice 2	SS	Social Service (Kind of work that require social activities with others)	
	Interest choice 3	MUS	Musical (Kind of work that require the ability to work with music)	
Achievement	Accademic	-	-	
	Non-accademic	-	-	
Choices	Student	Vocational School	-	
	Parent	Vocational School	-	
<b>Recommendation</b>				
Based on the student data; psychological test, accademic report, Achievement and Choices, the student is recommended to continue study in the vocational school.		Vocational School	Recommendation of interest is the <b>social science</b>	
			Yogyakarta, 10 Maret 2020	
School Principle			School's counsellor	

Figure 5. Individual Report

### Model Trial to Research Subjects

In general, the school represented by the school counselor was greatly helped by the application of the specialization model for the choice of study program in high school. The school provides input for the choice of interest which should be narrowed down to the three main interest choices because the choice of interest in the interest test has 12 choices according to rank. So that what is most needed is interest in ranking 1, 2 and 3 only to determine the choice of major in high school. From this input, revisions were made to the delivery of student interest choices described in Table 6.

Table 6. Aptitude's Table After Revision

Student's interest	Aptitude Choices	
First interest	OUT	Outdoor
Second interest	SS	Social Service
Third interest	MUS	Musical

The final result of the trial shows that the application of the developed specialization model is able to provide recommendations to students appropriately. The description of the results of the interest in the subject of the trial is presented in Table 7.

**Table 7. Final Assessment of Product**

No.	Conformity	Number of Respondents	Percentage %
1.	Conform	29	97 %
2.	Unconform	1	3 %
	Total	30	100 %

Based on the results, a discussion was held about the discrepancy between the results of one student's interest. Discussions were held with the first expert validators to test this application, namely school counselors and psychologists who have experience in administering psychological tests. The focus of the discussion is to determine whether the discrepancy occurs because of a discrepancy between learning achievement data, psychological tests, parental choices, and psychological tests.

Counselors and psychologists look for conformity according to the data obtained and it turns out that the discrepancy occurs because of the desire of parents and students to study natural science programs but is recommended to social science, after checking with data on learning achievement results and psychological test results, it turns out that the data shows the student concerned indeed leads to a social science study program.

Based on the discussion, it is known that the data used for adjustment of specialization with the results of pure recommendations comes from learning achievement data and psychological test results in accordance with the comparison of potential and competency values because these data tend to be stable or fixed. Meanwhile, the data on the wishes of students and parents are temporary or temporary based on wishes without considering the achievements and test results of students at school.

## DISCUSSION

The result of this development research is an application of a specialization model. The application of the specialization model has been tested for its effectiveness in helping school counselors provide recommendations that are suitable for students' conditions. Previous research has proven that the specialization model is feasible to use to help students determine further studies (Makrifah, 2014; Marlina et al., 2015). Other studies have also proven that the application of computer-based specialization models is suitable for use by school counselors (Aryani & Rais, 2017).

The developed specialization model application also shows accuracy in providing specialization recommendations to students. Applications of specialization models that meet the criteria of accuracy can answer the needs of school counselors to be able to provide appropriate specialization recommendations to students. This is because student career decision-making is a very important activity (Chinyamurindi et al., 2021; Gacohi et al., 2017; Zamroni, 2016). One of the urgency of the career specialization can be answered by using the application of the career specialization model that has been developed.

The application of the specialization model in this study is goal-based, which is to help students determine the specialization correctly and prevent students from having problems with the wrong major. So far, the target of the right specialization has not been achieved optimally. One of the reasons is that the specialization program is not optimal. This is evidenced by the rarity of special media to support individual specialization and planning services. If any, the media is not in accordance with the standards of specialization adapted (Siamah & Wiyono, 2018). So, in this study, the application of the developed specialization model has referred to the standard of specialization that has been determined in Regulations of the Ministry of Education and Culture no. 36 years 2018.

In a specialization model, both student personal data and class data are very important for the preparation of guidance and counseling programs as a follow-up (Gysbers & Henderson, 2014). This is also in line with the research results by Arifiyanti et al. (2017), which shows that the recommendation

of specialization must present individual or group conclusions. So, in the application of this model, individual or group or class conclusions are provided to make it easier for school counselors to classify students' data.

Another characteristic of the application of the developed specialization model is using Ms. Excel as a student data processor. The use of Ms. Excel makes it easy for school counselors because the Ms. Excel has been widely known. The utilization of Ms. Excel has also proven effective for managing students' data and helping decision-making (Pitrawati, 2016).

In addition, the concept of specialization states that aspects that must be considered in student specialization activities include learning achievement, non-academic achievements, national exam scores, student interests, aspirations and parental attention (Kemendikbud, 2018). These data are supported by reports of learning achievement and student psychological data, so that the recommendations for specialization given truly describe students' interests. This is in accordance with the characteristics of the student's career interest selection which must pay attention to aspects of interest, intelligence, academic achievement, and family support (Fenu et al., 2021; Yu-Chuan, 2019; Zaini et al., 2021).

Even though media availability in guidance and counseling services is essential, the counselor's skills are also significant. Hence, the school counselor needs to acquire basic skills such as attending, leading, reflecting, summarizing, interpreting, confronting, and informing/advising. The statement is related to the previous research that counseling skills are positively affected students' career choices (Hanif, 2021; Popescu, 2021). In that sense, the media is a tool, and the counselor's skills determine the instrument's effectiveness.

In the pilot phase on the subject, it was found that the wishes of parents were one of the obstacles that caused the recommendation of the specialization model to be inappropriate for students. This problem often occurs because parents' expectations for children are not in accordance with the competencies possessed by children (Hariyanto et al., 2014; Kustanti, 2019; Miski & Mawarpury, 2017). Besides, student's career identity is influenced by their environment and the people around them (Ching, 2021; Neuenschwander et al., 2018). To follow up on these problems, it is necessary to provide follow-up services in the form of consulting services and equalizing perceptions about students' interests between school counselors, parents and students.

The application of the specialization model for high school students is a product based on Ms. Excel has been proven to be effective in helping students determine further studies. This application also makes it easier for school counselors to provide specialization recommendations to students appropriately so that the problem of wrong majors can be minimized. Although external factors such as parental expectations must be considered to ensure the specialization recommendations given are in accordance with the competence and potential of students.

## CONCLUSION

The results of this study indicate that the application of the specialization model is appropriate to be used to help students determine majors in further studies. In addition, the application of the specialization model also has a positive influence on the career recommendations given by school counselors to students. The results of this study are relevant to the research objective, namely to develop a model of specialization that is suitable for use by school counselors. In the field of guidance and counseling, the results of this study offer strategy that can assist school counselors in providing individual planning services and student interests. The limitation of this research is that it only comes to product development, so it needs to be followed up by testing the effectiveness of the specialization model on a larger sample. In addition, the results of this study can also be followed up by developing a simpler application of the specialization model.

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