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Research Paper

Voices of Primary School Teachers About the Intelligent Material System Developed for Inclusive Education

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ABSTRACT

This study investigates the primary school teachers' perceptions towards the Intelligent Material System (IMS), which was developed to enhance the quality of inclusive environments and support the academic skills of students with Special Educational Needs (SEN). Within this scope, IMS training was conducted with 84 classroom teachers who worked at primary schools in İstanbul. Following the training, an open-ended questionnaire and two focus group interviews were used to collect data. The findings revealed that IMS has the potential to support the students with SEN academically, as it provides motivating and rich content, has a user-friendly interface and a desired level of accessibility despite the system's limitations and the need for improvements noted by the participants.

INTRODUCTION

Individuals with SEN are defined as those who show significant differences from their typically developing (TD) peers in terms of development, individual characteristics, and educational performance (Ministry of National Education [MoNE], 2018). Students with SEN require special education services and support depending on the individual differences within the identified group of inadequacy or difficulty (Kızılaslan et al., 2021). In addition, the curriculum, instruction, and materials need to be organized and adapted for these students (Polloway et al., 2018).

There are many studies in the literature that investigate the educational needs of students with SEN in inclusive settings. These studies indicate that teachers often emphasize the inadequacy of their knowledge acquired in both pre-service and in-service training, and they perceive themselves as inadequate in terms of playing an effective role in inclusive practices and using effective instructional strategies (Demir & Seçil, 2011; Hornby, 2015; Kamran et al., 2022; Sökmen et al., 2019; Yeo et al., 2016). In addition, teachers have reported that they cannot allocate enough time for their students with SEN (Saraç & Çolak, 2012), and they encounter problems due to material shortages (Erişkin et al., 2012; Shevlin et al., 2013). Teachers have also emphasized that they lack sufficient knowledge in preparing and implementing individual education programs for their students with SEN (Avcıoğlu, 2011) and that they have insufficient knowledge about making adaptations, creating activities and exercises appropriate for student level during course process (Sadioğlu, 2011).

Inclusion, which has become an important concept in today's education system, involves placing students with SEN in the same classrooms as their typically developing peers by providing special education support services instead of placing them in separate schools or classes (Lindsay, 2007). With this practice, students with SEN are provided with self-confidence and greater learning opportunities (Mesibov & Shea, 1996), and their academic and social development is positively supported (Berndsen & Luckner, 2012). However, the success of inclusive practices is influenced by many factors (Burke & Shutlerland, 2004; Ünal & Ahmetoğlu, 2017). In particular, the key role of teachers in inclusive practices is emphasized (Dahle, 2003; McGregor & Campbell, 2001; Yazıcı & Akman, 2018). Teachers' levels of knowledge, skills, experience, and effective classroom management (Fuchs, 2010; Sadler, 2005; Sucuoğlu, 2006) and their attitudes and awareness levels towards inclusive practices (Forlin et al., 2009; Sadler, 2005) affect the success of inclusive practices. However, research highlights the lack of teachers' knowledge, skills and experience levels, and low levels of attitudes and awareness towards inclusive practices (Buell et al., 1999; Burke & Shutlerland, 2004; Forlin et al., 2009; Sadler, 2005; Sucuoğlu et al., 2015).

In inclusive education, where full participation is adopted as a principle, technology that provides accessible and alternative ways is crucial for both inclusive environments and students with SEN (Foley & Ferri, 2012). However, in the literature, it is stated that

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teachers feel inadequate in using the internet and computers for educational purposes and struggle in preparing multimedia materials (Nazgul et al., 2020). Particularly, teachers who do not have sufficient technological skills may be unprepared for utilizing technology effectively (Cabero-Almenara et al., 2020). The insufficient knowledge of teachers regarding technology use and their lack of awareness about the advantages of technology use negatively affect their use of technology in inclusive environments to support different individual characteristics and promote full participation (Fälth & Selenius, 2022). In the study by Akcan and İlgar (2016), the classroom teachers reported that providing inclusive students with opportunities to use technological devices was one of the least implemented practices. Additionally, it is known that teachers emphasize the inadequacy of the technology infrastructure in the schools where they work (Sakalli-Demirok et al., 2019).

As seen in the researches, teachers experience time and material problems in inclusive practices and define themselves as inadequate in terms of adaptations of the course content and creating activities and materials suitable for the level of students (Erişkin et al., 2012; Sadioğlu 2011; Saraç & Çolak, 2012; Shevlin et al., 2013). As a solution to all these problems, it was targeted by the researchers to develop an Intelligent Material System (IMS) that will increase the quality of education in integration environments and increase teacher-student interaction to the desired level.

Intelligent Material System (IMS)

The current study's research team developed IMS as a system to improve teachers' individualized material preparation for SEN students. The current study's research team developed IMS as a system to improve teachers' individualized material preparation for SEN students. With IMS, the capacities of schools and teachers could be improved. The system allows teachers to develop high-quality teaching materials and reusable materials, allowing them to adopt the system based on the needs of their students since IMS provides the teacher with material suggestions according to the student's characteristics and learning objectives. While the instructional design and preparation of expert videos for IMS were being carried out, the software component, 2D and 3D visual drawings, and songs were developed. Within the system:

- Visual, audio, and textual support are provided to develop educational materials.
- Five songs, 95 3D materials, 410 2D images, 30 expert videos, and 14 application templates are included.
- 3D models that were already uploaded to the system be printed using an IMS-compatible 3D printer.
- Instructional tips on how to use a material with a student are also provided with expert videos.
- Each student’s profile could be created, their progress can be monitored, and support be provided with additional materials when needed.
- Teachers could develop mobile applications by making various changes to the templates uploaded to the system. These mobile applications can also be opened on the tablets and made available to their students.
- The objectives of the courses are listed. By matching a specific objective of a course with a specific skill, the teacher could design an individualized activity according to SEN students’ needs.

Within the scope of the study, 14 learning objectives for early literacy skills and 45 objectives for the first-grade Turkish Literacy curriculum were included in the initial assessment form and material suggestions (see screenshots of IMS in Figure 1 to Figure 3).

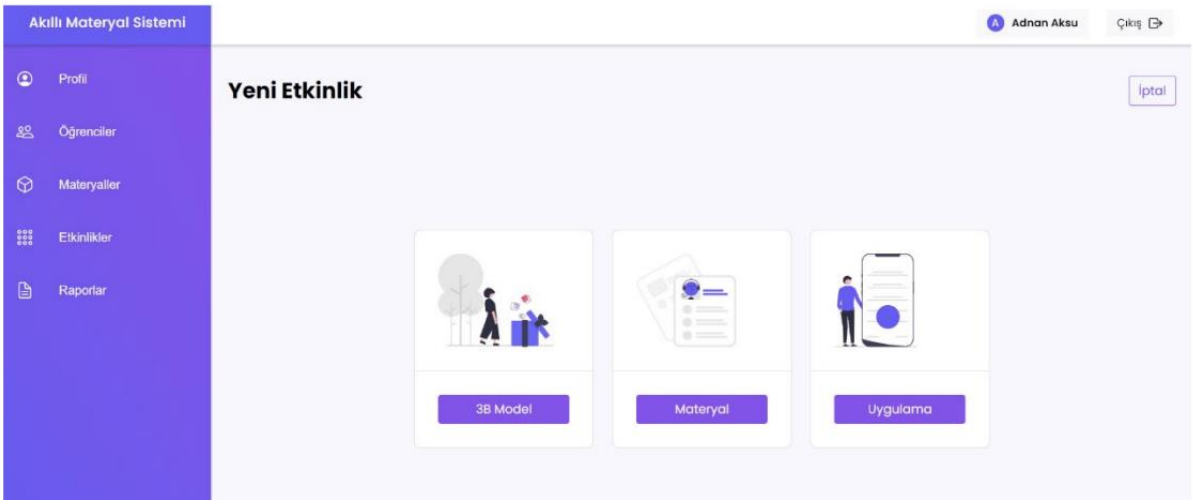

Figure 1. Activity type selection screen (3 different activity options: 1. Working on a 3D model, 2. A pool of ready-made materials related to the learning objective of the student, 3. The application area where the student can perform activities on the mobile application.)

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Figure 2. Student screen

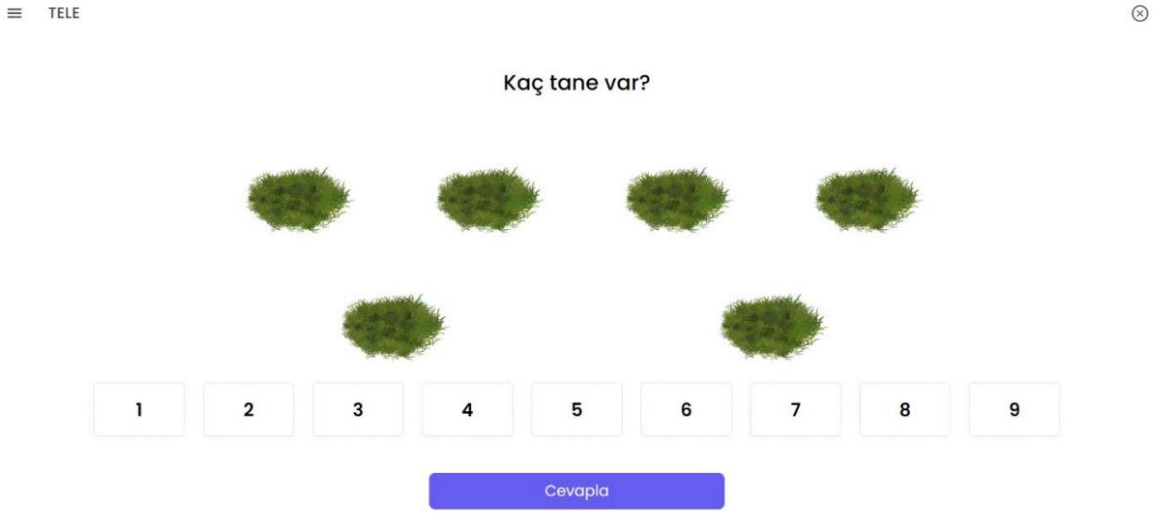

Figure 3. A sample activity screen from IMS

The IMS developed by the researchers of the current study is a user-friendly system that allows teachers to develop individualized materials for their students with SEN, receive material recommendations according to the characteristics of the students with SEN, and design materials aligned with the learning objectives of the course being taught. Also, IMS provides teachers with instructional expert videos on how to utilize the material with SEN students. This system, therefore, aims to find solutions to the problems teachers encounter when implementing inclusive practices.

In this study, IMS provided the infrastructure for teachers to use technology with SEN students. However, based on previous research, teachers do not prefer to use a technological platform separately with SEN students to strengthen their academic progress, and there is no infrastructure to support them for this purpose (Akcan & İlgar, 2016; Sakalli-Demirok et al., 2019). The current study differs from others in the literature in these respects. The IMS is quite important in that it is an easy-to-use material preparation software that helps teachers for the first time in this sense.

In this context, this study brings together the teacher, students with SEN, and technology in order to examine in depth the contribution of technology to inclusive practices based on the perspectives of teachers who have used the IMS system. Specifically, the purpose of this study is to investigate the perceptions and experiences of primary school teachers as a result of their hands-on experience using IMS for students with SEN, as well as to reveal the teachers' suggestions for improving this system. In light of these aims, answers to the following questions were sought:

1.What are the experiences of primary school teachers using IMS for students with SEN?
   a. What affordances do the teachers see of IMS for students with SEN?
   b. What limitations do the teachers see of IMS for students with SEN?
2.What are the teachers' suggestions to improve the use of IMS for students with SEN?

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METHOD

Context and Participants

Qualitative case study methodology (Creswell, 2007) was employed to investigate the perceptions of the primary school teachers regarding the use of IMS for SEN students. The study was conducted with classroom teachers from five primary schools in Istanbul Kagıthane District. The teachers who participated in the study consisted of teachers working in these schools and were selected on a voluntary basis. A total of 84 teachers from the five schools participated in the study, with their demographic information presented in Table 1. The participants were predominantly female, making up 64.3% of the total sample, while the remaining 35.7% were male. A significant proportion of the teachers (41.7%) were between the ages of 45-54. The majority of the teachers (86.9%) held a bachelor's degree, while only 13.1% held a master's degree. More than half of the teachers (51.2%) had 21 years or more of experience. Over half of the teachers (60.7%) reported having information technology competency partially.

Table 1. Demographic Information of Teachers

Variable	Group	N
Gender	Female	54
	Male	30
Specialty	Classroom teacher	72
	Other (such as Counseling)	12
Educational level of teachers	Undergraduate	73
	Graduate	11
Professional experience	0-5 years	2
	6-10 years	10
	11-15 years	13
	16-20 years	16
	21+ Years	43
Age	23-33	13
	35-44	30
	45-54	35
	55-64	6
Information Technology Competency	Yes	51
	Particially	33

Data Collection Tools

An open-ended questionnaire and two focus group interviews were employed to collect data, as triangulation and the use of multiple data sources are recommended in qualitative research (Richards, 2003) to obtain in-depth and comprehensive data. Before using the data collection tools for the main study, the researchers presented the questionnaire and interview questions to two special education experts and two educational technology experts and obtained feedback on their clarity and scope. The tools were then first piloted with three primary school teachers and revised based on their suggestions. Before using the data collection instruments for the main study, necessary ethics committee permissions were obtained.

Following the IMS trainings and workshops, an open-ended questionnaire was distributed to the participants to collect their opinions on the system. This questionnaire was developed by the researchers. In addition to the questions regarding the participants' demographic information, there were 11 open-ended questions that explored the affordances and limitations of IMS, as well as the participants' suggestions for enhancing IMS (Appendix A).

Focus Group Interview Form: It was developed by researchers. It contains 11 questions (Appendix B). The questions of the focus group interviews were based on the same themes that dominated the questionnaire: the benefits and affordances of IMS, as well as participant suggestions. The focus group interviews included semi-structured questions to gather in-depth data, and the participants were seated in a U-shape so that they could express their thoughts freely in a comfortable environment. A researcher from the research team was present during the focus group discussions to facilitate the conversation. The interviews were recorded using an audio recorder with the consent of the participants. Each interview lasted approximately 15-20 minutes.

Data Analysis

The collected qualitative data from the open-ended questionnaire and focus group interviews was transcribed and analyzed using the constant comparison method (Glaser & Strauss, 1967). The researchers annotated and specified codes after reading the transcripts repeatedly. As the codes began to emerge, categories and themes were generated through constant comparison of frequently occurring codes. Triangulation was provided by employing both open-ended questionnaire and focus group interviews.

The results were cross-validated through the examination of data gathered from both an open-ended questionnaire and the focus group interviews.

This process entails comparing and contrasting the themes identified in the questionnaire with those emerging from the focus group. Additionally, intercoder reliability was confirmed by having two independent coders code 20% of the data sample using a coding scheme (Cohen's kappa= 0.80).

To enhance reliability and internal validity, Merriam (1995) suggested the use of multiple data sources in the data collection process, also known as triangulation. In this particular study, diverse data collection tools were employed. Merriam (1988) emphasized the importance of documenting the data collection and analysis processes in a way that enables other researchers to replicate the study. Thus, detailed information was provided in the data collection and analysis sections to assist researchers and practitioners in replicating the study.

RESULTS

Overall, the analysis of the open-ended questionnaire and interviews revealed the affordances and limitations of using IMS for SEN students, as well as participant suggestions for improving the IMS. The results of the analysis were presented in accordance with the representative participant quotations.

Affordances of Using IMS for SEN Students

The first theme in the dataset consisted of evidence regarding the affordances of using IMS for SEN students. The first-hand IMS experience allowed participants to see what activities they can plan and what other options the system provides for their SEN students in accordance with the curriculum objectives. As depicted in Figure 4, under the theme of IMS affordances, four major features of IMS were categorized based on the statements of the participants: *resources, interface, area of utilization, and affective experience*.

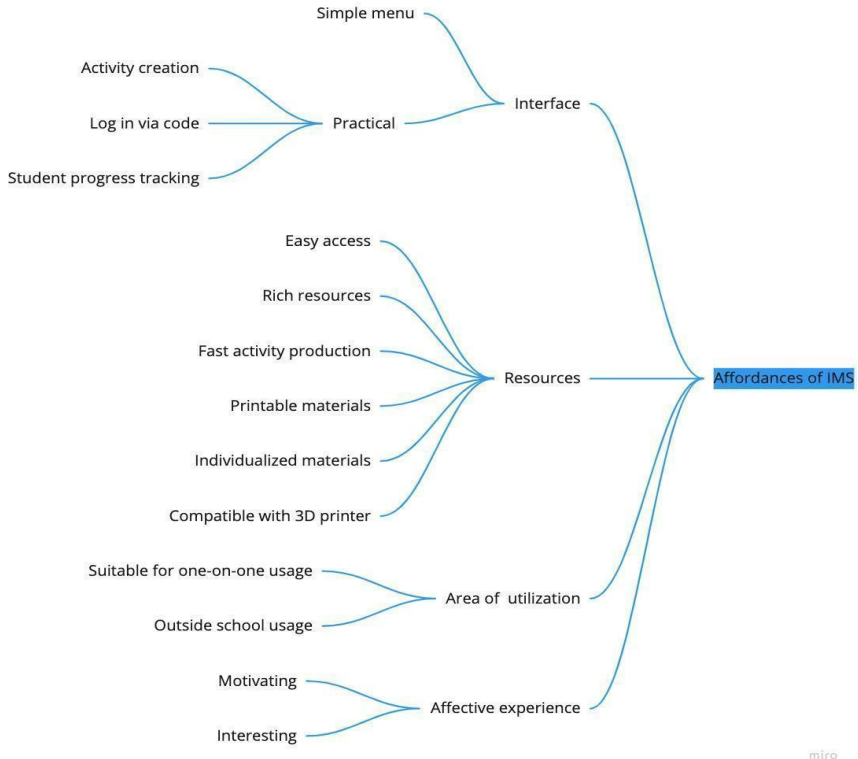

Figure 4. Themes, categories, and codes related to the affordances of IMS

When asked about the affordances of IMS, one of the most frequently mentioned categories was related to the *resources* IMS provided. The most repetitive statements were related to how easy it is to access the resources IMS consists of and how fast the teachers could produce activities by matching them with the related course objectives, as shown below in participants' utterances:

> *"It is simple and the materials are easy to access. The students can also easily access the resources."*
> *"In this system, it is very simple to produce an activity. I place a lot of value on being able to quickly develop activities on the subject we are dealing with."*

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In relation to the resources IMS offers, participants also frequently referred to IMS's extensive and printable resource library. Additionally, they mentioned IMS's compatibility with a 3D printer as a benefit to the system because using concrete objects when teaching SEN students is advantageous, as one participant highlighted:

> *"For example, if the student's visual intelligence is superior, when we design a 3D object, he/she will learn the target behavior more easily and in a shorter time."*

Another frequently mentioned affordance of IMS was that it provided the teachers with individualized materials that were tailored to each SEN student's needs. This demonstrated that teachers were attentive to individualization, one of the primary goals of the IMS system design. Furthermore, one of the most intriguing findings concerned the *interface* of IMS. Nearly every participant highlighted that IMS has a very simple menu and how practical it is for completing the tasks at hand, such as logging into the system, designing a new activity, and tracking students' progress, as the following comment illustrated clearly:

> *"The instructions and the menu are clear. Everything is very well thought out and the user interface is easy to navigate."*

On the other hand, another very frequently reported affordance of IMS was related to the IMS's utilization areas. The participants implied that they did not have adequate time to focus on the needs of the SEN students during class time; therefore, the fact that IMS provides an online platform where a teacher and a SEN student can use one-on-one in the support rooms could be a remedy for that issue. Another point brought up by the participants concerned the IMS's potential for use outside of the classroom, as teachers mentioned their intentions to assign students homework via the IMS as extra practice or support that they can work on independently or with the assistance of their parents.

Also, the affective experience IMS provided for the SEN students was commonly referred to by many participants. They mentioned that IMS could be motivating for the SEN students and it could aid the teachers in drawing the students' attention to the subject they are teaching as IMS offers hands-on activities accompanied by a wide variety of visual input.

Limitations of Using IMS for SEN Students

The second theme emerging from the data analysis consisted of evidence regarding the limitations of using IMS for SEN students. As depicted in Figure 5, under the theme of IMS limitations, four major categories were identified in the data based on the statements of the participants: *complicacy, unavailability, resource deficits, and conditions deficiency*.

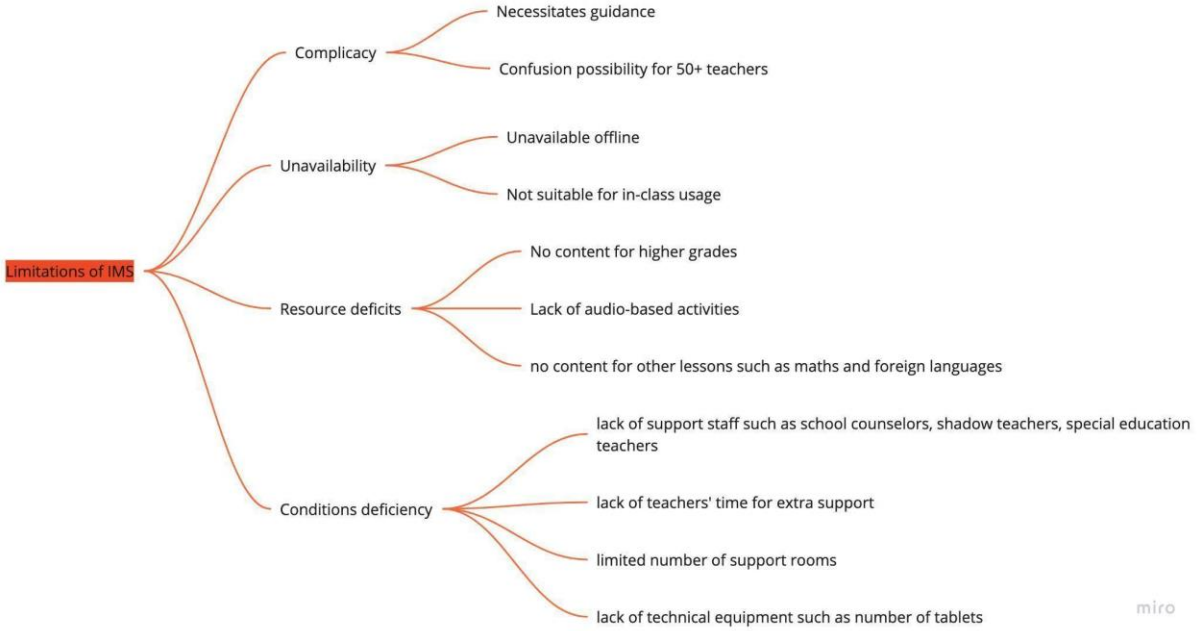

Figure 5. Themes, categories, and codes related to the limitations of IMS

According to the participants, one of the most frequently mentioned limitations that could impede the participants' effective use of IMS was the online-only nature of the system, which was coded under the category of IMS unavailability during the analysis. Participants indicated that they might have trouble using the system with their students in the event of any internet connection problems in their schools. Second, the participants repeatedly pointed out that IMS might not be suitable for in-class use as the inclusive classrooms are overcrowded (approximately 40-50 children) and the teachers cannot focus their attention on working with the SEN students exclusively:

> *"It would be difficult to use this system in crowded classrooms, as it is more suitable for one-on-one studying."*

On this issue, another participant drew attention to the individual differences of SEN students and the difficulty of using the same IMS activity for the entire class, as well as how IMS may be better suited for working individually with students with a lower cognitive level:

> *"In the classroom, the IMS activities may not be appropriate for students with a higher cognitive level, but in support rooms, these activities can be beneficial for working with lower-level students."*

Even though less frequently mentioned, the participants pointed out other possible limitations of IMS, such as how IMS may appear complicated to teachers with less digital competence and how they may require additional training to confidently use the system. In addition, deficits related to the resources of IMS were another salient subject regarding limitations. Especially, teachers who had visually impaired students in their classrooms emphasized the need for the IMS system to include more audio-based materials such as animal and letter sounds, songs, voice-based instructions and system feedback. Teachers also focused attention on the IMS system's lack of materials for other subjects, such as foreign languages and mathematics, and for higher grades.

Although not directly related to the limitations of the IMS system, the conditions of the schools, teachers and technical equipment were also included in the data because they indirectly affect the efficient use of IMS. The following comment exemplifies how certain factors may influence the students in schools where IMS is intended to be put into practice:

> *"For example, we have almost 30 SEN students in our school only. In other words, the number of our inclusion students is very high, but the number of support rooms is limited, and there are only 10 tablets. You know, also, the schedule for the available hours of the support rooms will be very limited."*

Suggestions of the Teachers for the Improvement of the IMS System

The main categories emerging from the data analysis for the suggestions of the participants to improve the IMS system are related to the *resources*, *activity improvement*, and *system advancement* (Figure 6).

Figure 6. Themes, categories, and codes related to the suggestions / improvement of IMS

Among the suggestions, the first category which was identified in the dataset is the *resources* the IMS might offer when necessary changes are made. The majority of participants indicated that IMS needs more visual and audio materials to draw students' attention to IMS tasks. Adding games/gamification elements to the system was also suggested as a method for increasing student interest and motivating them to complete the tasks, as many researchers today emphasize the importance of these elements for increasing student engagement. In addition, the participants highlighted the significance of enhancing the system's comprehensiveness by adding materials on additional subjects, such as mathematics, geography, and foreign languages, to IMS. The final code pertaining to resources discovered in the data was in the IMS's training videos. Several participants mentioned that they found the YouTube training videos included in the IMS system to be extremely useful. In light of this, they reflected on the necessity of increasing such videos, which could guide the teachers on how to design tasks suitable to the objectives of the course via utilizing IMS. The following quotations illustrate how the participants viewed the need to enhance IMS's resources:

> *"It is important that the system includes visual and audio-based materials. Especially the audio-based materials such as songs, animal voices, voice-based directions could be very useful."*

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> *"I believe it is essential for activities to be gamified and visually oriented. For instance, when a student accomplishes something, s/he may receive positive reinforcement. For instance, the system awards a heart emoji to a student who provides the correct response."*

> *"The content and number of the training videos should be enriched. There may be guiding, instructional videos that give instructions to both teachers and students about applications and tasks. Thus, homework can also be given through the system."*

Moreover, it was observed that participant quotations frequently emphasized the significance of taking additional actions for the continuous improvement of the system and the adaptation of the users. For instance, the participants indicated that it is essential for the researchers to offer future teacher and parent trainings, as one teacher reflected:

> *"We need a lot of technical support. In other words, we cannot keep this system in mind by seeing it here for once. It takes a lot of practice. We need further training sessions for this."*

Also, even though feedback on IMS was collected following the training, the teachers indicated that a second feedback session would need to be organized once the system is tested with SEN students. In addition, the classroom teachers indicated that they may require the assistance of shadow teachers during class hours in order to successfully utilize IMS:

> *"For instance, having a shadow teacher with us during class hours makes our job much easier because the classes are obviously overcrowded and we can't devote much time to SEN students. However, with the shadow teacher present in the classroom, I believe we can use this system in the classroom."*

In terms of system feature development, participants suggested enabling certain features on the IMS system to facilitate teaching via IMS, such as allowing teachers to combine multiple objectives when designing an activity and allowing students to work in groups while using IMS for achieving a common outcome.

All in all, these quotations on the affordances, limitations, and suggestions on IMS reflected IMS's potential for SEN students and the participants had a positive perspective overall although they pointed out a few limitations such as resource deficits, complicacy, lack of offline usage, difficulty of in-class usage, and conditions deficiency.

DISCUSSION

In the first research question, teachers' IMS usage experiences were identified. As a general evaluation of their IMS experience, the participants highlighted the system's straightforwardness and user-friendliness. They also mentioned that they found IMS highly functional in fulfilling the requirements of the Ministry of National Education (MoNE) curriculum they adhere to. When reviewing the literature, many studies have pointed out the difficulties teachers face in including SEN students in instructional activities in inclusive settings (Andrian et al., 2022; Cooc, 2019; Çetin, 2004; Erişkin et al., 2012; Florian, 2019; Sadioğlu, 2011; Sadioğlu et al., 2012; Saloviita, 2020; Shevlin et al., 2013; Söğüt & Deniz, 2018). These difficulties are often attributed to the impossibility of providing individual support due to large class sizes, failure in classroom management, or the inapplicability of methods and materials in crowded classrooms (Akalın, 2015; Fuchs, 2010; Karabıyık & Işıkdoğan Uğurlu, 2019; Nazgul et al., 2020; Sucuoğlu, 2006). The functionality of IMS and its benefits, such as providing individualized materials, immediate feedback and correction to the child, are frequently mentioned in the literature as potential solutions to these issues. IMS not only allows for activities and applications on a digital platform but also has the capacity for 3D materials, which can support concrete and lasting learning experiences. Examining the opinions of the participants revealed that SEN students can achieve faster and more lasting learning with 3D materials. This view is consistent with the findings of previous research (Acenas & Dalonos, 2020; Lam et al., 2020). The participants of the study also expressed their views on the significant advantages of IMS in terms of rapid assessment and providing support without wasting time. Reviewing the literature reveals that in order for SEN children to demonstrate similar performance to their TD peers and catch up with them developmentally, it is necessary to identify them early and initiate an intensive support and education process (Birkan, 2002; Pretti-Frontczak & Brickman, 2007). Although educational placement decisions are made by the Guidance and Research Center, it is believed that IMS's ability to assess children who have received a diagnosis or are at risk and its capacity to aid in the development of a rapid support education program play a significant role in enabling SEN children to demonstrate academic performance comparable to that of their TD peers.

With the first research question, the limitations of IMS were also identified. The participants frequently reported that IMS is considered a more suitable platform for individual instruction and may be limited for group education. However, inclusive education is predicated on the principle that students with SEN and TD receive education together (Kargın, 2004). Also, peer-mediated instructional practices are known to be effective methods in inclusive settings (Copeland et al., 2004; Lancaster et al., 2023; Trausch et al., 2022; Tümeğ & Sazak-Pınar, 2016). Tracy and Wallace (2016) stated in their study that peer-mediated instructional models have positive outcomes not only for SEN children but also for TD children. They mentioned that supporting the SEN peer contributes to the enhancement of various skills such as self-esteem, confidence, and coping with difficulties. Therefore, the participants of this study have a valid point, and IMS must be enhanced so that SEN students can collaborate with their peers in groups. In addition,

when peer-mediated methods are used in conjunction with IMS applications, it is believed that the positive self-perception and other individual characteristics of TD children can also be supported. Lastly, other opinions regarding the limitations and inadequacies of IMS are found to be related not to the technical or content features of the system but rather to the physical classroom environment, technical facilities of the school, or other external factors.

Within the scope of the second research question, views and recommendations for the enhancement of IMS were obtained. It was seen that there was mostly positive feedback towards the system. Previous research also supports the development of technological materials, technology-supported applications, and software for individuals with SEN (Çağıltay et al., 2019; Edyburn, 2013; Thomas et al., 2019). In a study by Edyburn (2013), it was emphasized that special education technologies should be purposeful, suitable for individual characteristics and needs, and clear and comprehensible. Participants frequently aligned these characteristics from Edyburn's (2013) study to those of IMS, indicating that IMS may be an appropriate fit for the needs of SEN students. Participants in the study conducted by Thomas et al. (2019) emphasized that special education technologies should be content-appropriate and easily accessible to both teachers and students. In the present study, teachers emphasized that IMS is rich in content, open-source, appropriate for students, and accessible to teachers. In a study conducted by Çağıltay et al. (2019), it was stated that teachers mostly emphasized the limited content related to special education technologies. The participants in our study also frequently emphasized the importance of content richness, and in this sense, it is believed that IMS will contribute to the existing gap in the field.

CONCLUSION, LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH AND PRACTICE

This study shed light on the affordances, limitations, and suggestions related to the use of IMS for students with SEN. The study revealed several key affordances of IMS that were frequently mentioned by the participants. The resources provided by IMS were deemed easily accessible and enabled quick activity production aligned with curriculum objectives. The extensive and printable resource library, as well as compatibility with a 3D printer, were mentioned as beneficial features. The individualized materials tailored to the needs of SEN students were also appreciated. The user-friendly interface of IMS, with a clear menu and practical navigation, was highlighted as a positive aspect. Additionally, the online platform of IMS offered the potential for one-on-one support and extended utilization beyond the classroom.

Overall, while the study highlighted the potential benefits of IMS for SEN students, it also highlighted areas for improvement and addressed important considerations regarding its implementation. To illustrate, it was suggested that IMS's resources be improved by incorporating more visual and audio materials, as well as gamification elements, and by expanding subject coverage. The importance of training videos and ongoing support for teachers and parents was emphasized. Participants also highlighted the need for further feedback sessions, testing IMS with SEN students, and considering the assistance of shadow teachers during classroom implementation. Suggestions were made to enable additional features in the system, such as combining multiple objectives in activity design and facilitating activities based on group work for students.

The study also revealed the limitations associated with the use of IMS for SEN students. The online-only nature of the system was seen as a potential barrier, particularly in cases of internet connection issues. The overcrowded inclusive classrooms posed challenges for effective implementation of IMS, as it was considered more suitable for one-on-one interactions. The individual differences among SEN students and the need for differentiated activities were also mentioned as potential limitations. Furthermore, concerns were raised about how challenging IMS could be for teachers with limited digital competence, the lack of audio-based materials for visually impaired students, and the need for broader subject coverage and materials for higher grades.

In addition, regarding the study's limitations, currently IMS content is limited to 1st-grade Turkish language skills and early literacy skills. Therefore, for a comprehensive evaluation of IMS's potential by the teachers, further feedback needs to be obtained when IMS content includes other subjects and their objectives, and the findings of this study should be updated accordingly. Because the teachers did not have the opportunity to use IMS with their SEN students, the study's findings are only preliminary and based on the teachers' initial impressions. Therefore, additional feedback must be received when IMS is implemented in a school setting so that its full potential can be evaluated. Additionally, in this study, the IMS evaluation was solely based on the teachers' opinions. It is recommended for future research to implement IMS with SEN children and evaluate it holistically, taking into account student opinions as well. In general, the findings provide valuable insights for further development and refinement of IMS to better support the academic needs of students with SEN.

Beyond that, the implications of the study provide essential perspectives and recommendations for the use of IMS with SEN students. These implications can guide further development and refinement of IMS to better meet the academic needs of SEN students. The key implications are as follows:

- Incorporate more visual and audio materials into the IMS system to cater to the diverse characteristics and needs of SEN students: By providing a variety of sensory inputs, IMS can offer a more engaging and inclusive learning experience.
- Expand IMS content coverage to include other subjects and objectives: Currently limited to 1st-grade Turkish language skills and early literacy skills, this expansion will enable teachers to evaluate its effectiveness across a broader range of academic areas and ensure its applicability throughout the curriculum.

- Provide further and continuous training for teachers: Recognizing that IMS could be demanding for teachers with limited digital competence, it is crucial to provide comprehensive training and ongoing support to educators. Training videos and continued professional development opportunities can empower teachers to effectively navigate and utilize IMS in their classrooms.
- Include all parties for system evaluation: To obtain a comprehensive evaluation of IMS, future research should involve implementing IMS directly with SEN students and collecting their opinions and experiences. Including the perspectives of SEN students will provide valuable insights into the system's usability, accessibility, and impact on their learning outcomes.
- Conduct classroom-based evaluation: As the study findings were based on teachers' initial impressions rather than actual implementation with SEN students, it is essential to conduct further research in real educational settings. Observing IMS implementation in inclusive classrooms with the participation of SEN students will enable the researchers to access a broader picture and have a more accurate assessment of its effectiveness and practicality.
- Given the challenges of overcrowded inclusive classrooms, the study suggests considering the assistance of shadow teachers during the implementation of IMS. Shadow teachers can provide additional support to students with SEN, ensuring that they can fully benefit from IMS resources and activities.
- Participants recommended enabling features in IMS that support the combination of multiple objectives in activity design and facilitate group work among students. These features can enhance collaborative learning and address the individual differences and social interaction needs of SEN students.

By considering these implications, developers and educators can collaborate to address the limitations, incorporate the suggestions, and ensure that IMS is effectively designed and implemented to support the diverse learning needs of students with SEN.

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Appendix A. Open-ended Questions

1. Your Age
2. Your Years of Experience
3. How is the technical usability of the IMS system?
4. Can you actively use the IMS system?
5. How does the IMS system help you in meeting your students' needs?
6. Challenging aspects of the IMS system:
7. Aspects of the IMS system that I like:
8. I can use the IMS system to support my students in the following areas:
9. The IMS system might be inadequate in the following areas:
10. The IMS system could be improved because…
11. Additional comments you would like to add about the IMS system

Appendix B. Interview Questions

1. Can you briefly tell us about your experience with the intelligent material system?
2. Would the intelligent material system be useful in teaching and facilitating early reading and writing skills in the curriculum? How?
3. Could there be other benefits of the intelligent material system? What are they?
4. Is the intelligent material system user-friendly? In other words, was it easy for you to adapt to using this system? Please explain.
5. Did you encounter any difficulties while using the intelligent material system? If so, what were they? How did you overcome these difficulties, and what kind of support did you need?
6. Did the intelligent material system present you with any difficulties during use? Please explain.
7. Are there any aspects of this system you would like to see improved? Any suggestions?
8. Do you think you will actively use the intelligent material system when working with your students? Why?
9. In your opinion, how will the intelligent material system support your teaching at certain points or aspects?
10. How would you evaluate the intelligent material system in terms of meeting needs?
11. Do you have any comments/suggestions to add, or any questions you would like to ask?