Pedagogical Research
2024, 9(1), em0183
e-ISSN: 2468-4929
https://www.pedagogicalresearch.com

MODESTUM

Research Article **OPEN ACCESS**

An analysis of number sense skills of Syrian immigrant students by gender and duration of stay

Bedirhan Teke [1*], Recai Akkaya [2]

[1] Department of Mathematics and Science Education, Kilisli Muallim Rifat Faculty of Education, Kilis 7 Aralik University, Kilis, TÜRKİYE
[2] Department of Mathematics and Science Education, Faculty of Education, Bolu Abant Izzet Baysal University, Bolu, TÜRKİYE
*Corresponding Author: bedirhan.teke@kilis.edu.tr

Citation: Teke, B., & Akkaya, R. (2024). An analysis of number sense skills of Syrian immigrant students by gender and duration of stay. *Pedagogical Research, 9*(1), em0183. https://doi.org/10.29333/pr/14053

ARTICLE INFO

Received: 04 Aug. 2023

Accepted: 11 Dec. 2023

ABSTRACT

Considering the negative situations faced by the migrating societies, it is known that the language and culture factors exert a stronger influence on the mathematics course than the other undesirable conditions. From this perspective, it is known that the mathematical performance of individuals is likely to increase by placing the concept of number sense in the center. Therefore, the present study aimed to examine the number sense skills of Syrian immigrant students with reference to gender and duration of stay as an immigrant as well as to determine their conceptual awareness of number sense-related components. The descriptive correlational design was used in this study in which 152 immigrant students participated. Web-based two-tier test was used in the data collection process, and descriptive statistical values and t-test for independent samples in the analysis of the data. As a result, it was found that male students compared to female students, as well as those who had been immigrants in Turkey for a long time compared to those for a shorter time showed higher number sense performances, though most of the students were at a low number sense level. In addition, the differences appeared significantly in relation to the variables of gender and duration of stay as an immigrant. A surprising result is that most students preferred number sense-based solutions as the basis for their answers. It can thus be concluded that the number sense performances of Syrian immigrant students are lower than expected and that future studies are needed not only to focus on teachers but also on teaching methods and materials in order to take immigrant problems under control and to come up with solutions with a view to overcome such challenges.

Keywords: immigrant students, number sense, Turkey, web-based two-tier test

INTRODUCTION

In recent years, the increased wave of immigration to our country has made the issue of the integration of immigrants necessary. In this context, it is known that one of the most important ways of ensuring the integration of immigrants is education (Bahadir, 2021). Schools and education have therefore played an important role in the integration of immigrant children. The fundamental element in the education of immigrant children is language teaching. Furthermore, the integration process is likely to be carried out more healthily by ensuring that such children acquire various skills (problem-solving, reasoning, etc.) as a result of the teaching process. Teaching mathematics has grown in importance to make sure that necessary skills will be acquired. Since mathematics is a universal language, it will be possible to communicate in mathematical terms and to help them to develop skills in four basic mathematical operations as well as some other skills in daily life. In addition, the acquisition of arithmetic skills used in daily life will contribute to the integration of immigrant students. In this respect, it is of great importance to reveal the immigrant children's extent of knowledge about the number sense skills, which are based on their arithmetic skills. In this study, the number sense skills of immigrant students will be discussed by taking various variables (gender and duration of stay as an immigrant) into consideration.

Number Sense

Many questions such as "What is number sense? How is it examined? What are its components?" are still a matter of curiosity by researchers though there is no certain consensus over them (Jordan et al., 2007; Verschaffel et al., 2007). The relevant literature has shown that there is more than one definition for the concept of number sense. Hope (1989), for example, defined number sense as making logical estimations of numbers, finding mathematical errors, if any, choosing an efficient way of calculating, and discovering number patterns. Howden (1989) associated the concept of number sense with daily life and expressed it as being aware of the relationships between number sense and daily life. Being a little more specific, Greeno (1991), on the other hand, defined number sense as being aware of the possibilities in the context, using these possibilities within the scope of activities,

understanding hidden patterns and interpreting them in line with meaning, while Markovits and Sowder (1994) considered mental calculations as a combination of the capability of highlighting, making estimations, transferring between different number representations, measuring number magnitudes, and interpreting measurement results. Based on these explanations, Yang (1995) expressed the concept of number sense as the ability of an individual to make use of the pieces of knowledge about numbers in the problems encountered in daily life. According to Reys and Yang (1998), number sense is the ability to direct students so that they can find appropriate ways to handle situations related to numbers and operations by developing appropriate strategies for the situations they encounter. Based on this definition, Reys et al. (1999) defined this concept as the ability to use mathematical reasoning while dealing with numbers and operations, in addition to the general definition of the concept of number sense. Considering the pertinent definitions provided in the literature, Yang and Wu (2010) stated that number sense is generally a number-operation relationship and a complex but flexible structure that allows the development of creative and effective mathematical thinking skills related to this relationship. In line with such definitions of the number sense, it was indicated by National Council of Teachers of Mathematics (NCTM) that the term comprises the skills of understanding numbers and ways of representing them, understanding the relationships among numbers and number systems, and making estimations by making calculations (NCTM, 2000).

Theoretical Framework

The main purpose of the education systems of countries is to prepare individuals for real life, and in line with this purpose, to ensure the development of reasoning skills by encouraging individuals to think critically in the face of problems (Ministry of National Education [MNE], 2018). Given the definitions of the concept of number sense provided in the literature, it is clear that number sense plays a critical role in mathematics teaching. For example, Yang et al. (2008) found a significant correlation between number sense skills and mathematics achievement. Similarly, Kayhan Altay (2010) reported a positive correlation between number sense skills and students' mathematics performance. Yang and Wu (2010), on the other hand, suggested that students' mathematics achievement increased, and they became more successful in real- life problems as a result of placing the number sense in the center of learning. It can be argued that the use of the concept of number sense in mathematics teaching is likely to help raise individuals who can question, think critically, and have high mathematical reasoning skills, thereby having a positive impact on mathematics performance. Despite this, there is no consensus in the literature on the definition of the concept of number sense and what its components are (Yang et al., 2008).

The components of number sense represent the existence of the number sense ability of individuals. While Greeno (1991) expresses this ability as quantitative judgment and making inferences through mental computation and estimations, McIntosh et al. (1992) added depth to this explanation and considered it as the ability and knowledge related to numbers, operations and the computational applications of these two fields. Markovits and Sowder (1994), as another example, gathered the components of number sense under three headings as number magnitude, mental computation, and computational estimations, based on Greeno (1991)'s classification.

As a result of their experimental study, Jordan et al. (2006) emphasized a structure with five components (counting, number knowledge, number transformation, estimation, and number patterns) in the determination of number sense ability, while Kayhan Altay and Umay (2013) revealed a structure with three components: flexibility in calculation, conceptual thinking in fractions and use of references. Yang and Li (2017) classified the number sense components under five headings when compared to these explanations and classifications, thereby presenting a general framework in this regard. The titles and general framework presented by Yang and Li (2017) have been taken into the centre and will be explained later in the study.

Although the phenomenon of mathematics is in all areas of life, students tend to perceive mathematics negatively due to certain factors such as its being an abstract discipline (Burton, 2012), the linguistic and cultural problems that arise as a result of the migration of students (Bahadir, 2021), the presence of negative environmental impact (Wahid et al., 2014), some challenging situations (e.g., wars), lack of mathematical knowledge that may occur due to such problems (Paras, 2001), and disregarding the cultural harmony in the curricula (Bakalevu, 1998). However, the cultural factor among these negative impacts plays a more significant role than others when immigrant students are taken into consideration. The reason for this may be that immigrants put their education into the back burner while being exposed to new cultural environments (Brilliant, 2000). However, it is impossible to consider mathematics separately from culture (Planas & Valero 2016). For that reason, it can be suggested that the new culture that immigrant students are exposed to directly affects their number sense skills within the scope of mathematics. Some researchers (Bakalevu, 1998; Levels et al., 2008; OECD, 2015) have indicated that the mathematics achievement of migrant communities is below the acceptable limit.

The literature review has revealed some studies that have examined the number sense skills of immigrants. For example, Geva and Benhamu (2020) made use of the Marzano's six-step process in an effort to investigate to what extent the process (used to support students in the development of vocabulary in a wide range of topics) can facilitate the mathematical vocabulary of 30 Syrian immigrant students from grade 1 to grade 7. As a result of the study, it was reported that the process could support the development of mathematical vocabulary and underlying mathematical concepts in classes with immigrant students. Moreover, Chen et al. (2015) aimed to understand the differences in number sense performance between immigrant students and those at different levels and classes (students with lower SES besides those studying at fourth, fifth, and sixth grades). As a result of the study, a statistically significant difference was found in number sense performance between immigrant students, students with lower SES, and normal students in the fourth, fifth, and sixth grades.

In a similar sense, there are studies in the literature that compare the number sense skills of immigrant students with others (Petersson, 2018; Votruba-Drzal et al., 2015; Zhang & Han, 2017) and that reveal the family factor as an important element in determining the number sense skills of immigrant students (Maulbeck, 2021; Takeuchi, 2016; Zamora, 2015). The present study is

Table 1. Distribution of 8th grade immigrant students by gender & duration of stay as an immigrant

Variables	Male	Female	Frequency (f)	Percentage (%)
9 years and less (younger group)	35	36	71	46.71
10 years and over (older group)	38	43	81	53.29
Total	73	79	152	100

Note. Considering density in number of students & distribution by gender, binary grouping was made (younger group-older group)

considered important in that the number of studies on immigrant students is limited; there is also a lack of studies that have focused on the number sense skills of Syrian immigrant students studying in multicultural secondary schools, on such skills in terms of students' gender and the duration of stay as an immigrant, as well as on such students' conceptual awareness of number sense components. Therefore, the implementation of the planned measurement tool, web-based two-tier test (WTTT-NS), is believed to contribute to the literature on mathematics education in terms of number sense studies and it is suggested that the results of the study can be used to improve the educational activities of students from both cultures.

In this context, it is aimed to determine the number sense skills of Syrian immigrant students studying in secondary schools with a middle socio-economic level, and to reveal the pattern of distribution and differences, if any, of these identified skills in terms of gender and duration of stay as an immigrant. With this purpose, answers will be sought to the following research questions:

1. Do the number sense skills of Syrian immigrant students differ by gender and duration of stay as an immigrant?
2. What is the level of conceptual awareness of the number sense components of Syrian migrant students studying in secondary schools with a middle socio-economic level?

METHOD

Research Method & Design

This study involved a number of immigrant students as participants and employed the survey research method in order to determine the extent of the number sense skills of the participants. Survey models are research approaches adopted with the aim of describing a past or present situation as it is. It is not possible for the investigated feature to undergo a change or be affected (Can, 2023). Moreover, as it was aimed to determine the number sense performances of Syrian immigrant students without providing any instruction in this regard, the descriptive survey model was used in this study.

Research Population & Sample

In the process of determining the participants of the study, it was decided that the population would be the 8th grade immigrant students in Turkey and the sample be the 8th grade level immigrant students (184) studying in secondary schools selected by random sampling method in the 2022/23 academic year in Kilis. For this purpose, the administrators of the selected schools were contacted, and the students were provided with the student-based participant approval form. Those who agreed to participate in the study were then given the parental consent forms, which were collected back one day later. In line with the feedback received, the study was conducted with the participation of a total of 152 students: 73 male and 79 female students. **Table 1** presents the descriptive statistics values of the participants.

Data Collection Tool

Developed by Yang and Li (2017) and translated into Turkish by Caglar (2021) within the scope of a doctoral thesis and on the grounds of necessary permissions, WTTT-NS was employed as the data collection tool of this study. A number of different ways exist in the literature with a view to determine the number sense skill. For example, number sense skills can be evaluated using pencil and paper, as well as using computer-assisted measurement tools to evaluate these skills. Likewise, Reys and Yang (1998) aimed to determine the number sense test in written form, and Yang and Li (2017) determine the number sense test with WTTT-NS. In this application process, the five-component number sense structure prepared by Yang and Li (2017) (*understanding the meaning of numbers, recognizing the relative number size, being able to use different representations of numbers and operations, recognizing the relative effects of an operation on numbers, and being able to judge the reasonableness of a computational result*) was adapted and used for scoring and analyzing the test. In addition, the data collection tool, which includes four questions for each component and 20 questions in total, was transferred to Google Forms by the researchers and presented to the participants by obtaining the necessary permissions during the use of WTTT-NS. **Table 2** presents the component-question matching and component-based explanation, as well as reliability, item difficulty, and item discrimination index values.

Implementation of WTTT-NS

WTTT-NS is a two-tier test; in the first stage, students are presented with a multiple-choice question about the subject, while the second stage is based on the students' preferred answer (i.e., what is the answer?). In the second stage, the reason for the preferred answer in the first stage is investigated (i.e., what is your reason for giving this answer?). If a student chooses the correct answer in the first stage, he or she is given the "I am guessing" option, along with the explanations for number sense, misconceptions, and rule-based solution for the reason for the answer given in the second stage. If the student chooses the wrong answer in the first stage, explanations about the misconception as the reason for the wrong answer and the option, "I am guessing", are presented to the student in the second stage. **Figure 1** shows an example application of this test.

Table 2. Statistical values for WTTT-NS

Components	Component description	QWTTT-NS	R	IDI	IDSI
Understanding meaning of numbers (C1)	Making sense of number systems (including integers, fractions, & decimals), & some aspects such as place value & four basic operations (Yang, 2019).	1-2-3-4	0.81	0.48	0.54
Recognizing relative number size (C2)	Comparing & sorting numbers (Yang, 2019)	5-6-7-8	0.80	0.51	0.58
Being able to use different representations of numbers & operations (C3)	Using multiple representations in solving numerical problems (Yang et al., 2008)	9-10-11-12	0.83	0.50	0.54
Recognizing relative effects of an operation on numbers (C4)	Being aware of effects of four operations on results (McIntosh et al., 1992; Yang et al., 2008)	13-14-15-16	0.81	0.50	0.49
Judging reasonableness of a computational result (C5)	Thinking about result through mental computation without using a pen & paper (McIntosh et al., 1992; Yang, 2019)	17-18-19-20	0.79	0.50	0.55
Mean			0.90	0.49	0.54

Note. QWTTT-NS: Question items in WTTT-NS; R: Reliability; IDI: Item difficulty index; & IDSI: Item discrimination index

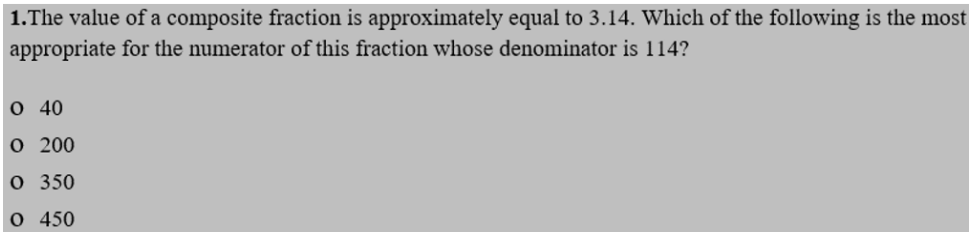


Figure 1. A sample question to understand meaning of numbers (Caglar, 2021; Yang & Li, 2017)

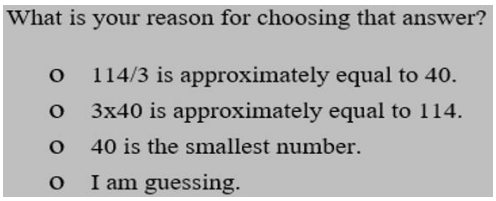


Figure 2. Window to appear for an incorrect answer-1 (Caglar, 2021; Yang & Li, 2017)

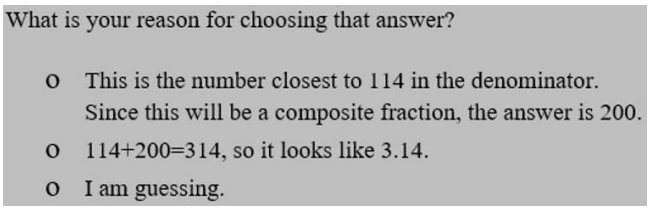


Figure 3. Window to appear for an incorrect answer-2 (Caglar, 2021; Yang & Li, 2017)

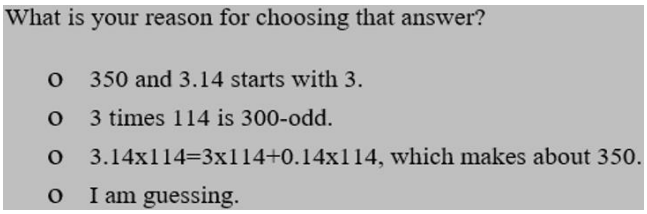


Figure 4. Window to appear for a correct answer (Caglar, 2021; Yang & Li, 2017)

When the student's answer to the question in **Figure 1** was "40", the window to appear is shown in **Figure 2**.

When the student's answer to the question in **Figure 1** was "200", the window to appear is shown in **Figure 3**.

When the student's answer to the question in **Figure 1** was "350", the window to appear is shown in **Figure 4**.

When the student's answer to the question in **Figure 1** was "450", the window to appear is shown in **Figure 5**.

To ensure the reliability of the test, the students were prevented from changing their preferences in the first stage based on the reason window opened for the answer they preferred in the first stage. In addition, the students were informed by the researchers about how to use a web-based test. During the implementation of WTTT-NS, the students who wanted to use a pen and paper were informed as to why they should not use them, thus it was made possible to observe the number sense skills of the students (Yang & Cheung, 2020; Yang & Li, 2008).

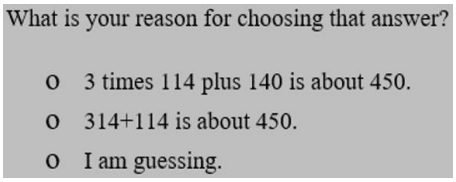


Figure 5. Window to appear for an incorrect answer-3 (Caglar, 2021; Yang & Li, 2017)

Table 3. WTTT-NS scoring chart (Yang & Li, 2017)

Answer (first stage)	**If true**				**If false**
	Four points				**Zero point**
Reason for answer (second stage)	Number sense-based	Rule-based	Misconception	Estimation	
	4	2	1	0	0
Total score	8	6	5	4	0

Table 4. Examining normality of data set

Components	**Skewness**	**Kurtosis**
Score for component C1	0.790	-0.127
Score for component C2	0.457	-0.571
Score for component C3	0.556	-0.130
Score for component C4	0.128	-0.786
Score for component C5	0.503	-0.613
WTTT-NS	0.627	-0.103

In scoring the data, the same format was used for each item, which is presented in **Table 3**.

Data Analysis

First of all, the range of scores the students would get in line with their answers in WTTT-NS was determined in the data analysis process. Then, the student answers in Google Forms were transferred into Excel format by the researchers and the students were coded in terms of their duration of stay as an immigrant, gender, and rank. For example, the coding of the second-ranked female student with a nine-year immigrant status is "9K2" (younger group), while that of the 3rd ranked male student, who had been in immigrant status for 11 years, is "11E3" (older group).

As a result of this process, the scores received by the students for the number sense components were calculated and categorized on a group basis. In this categorization process, the participant answers were investigated as to whether or not there were any answers to be considered as missing data in student answers, yet no question was found to have been left unanswered. After the categorization process, whether or not the data group of each component and WTTT-NS showed normal distribution was tested. **Table 4** shows the output of the SPSS 25.0 package program for this process.

Morgan et al. (2004, p. 49) stated that for a data set to show a normal distribution, skewness and kurtosis values should be within the range of ±1. According to this assumption, it is accepted that the data set belonging to the number sense components and WTTT-NS show normal distribution characteristics. Since the scores in the data set were at least in the interval scale (Can, 2023, p. 83), parametric tests were employed for the purpose of this study. In the analysis of the problem statement given as "Do the number sense skills of Syrian immigrant students differ by gender and duration of stay as an immigrant", firstly, descriptive statistical values of the data set were calculated according to the variables of gender and duration of stay as an immigrant, within the scope of WTTT-NS and number sense components. After these calculations, the normally distributed data set was regrouped within the scope of the variables and the normal distribution features were obtained. In the analysis of the normally distributed data set, whether or not there was a statistical significance between the groups in the scope of the variables was calculated with the *t*-test for independent samples.

In the analysis of the sub-problem "What is the level of conceptual awareness as regards the number sense components in Syrian immigrant students studying in secondary schools at a middle socio-economic level?", firstly, the reasons that the students in the groups preferred in the second stage within the scope of the components and WTTT-NS were determined and descriptive analyses were made. Then, mean number sense scores for group-based WTTT-NS overall score and number sense components were calculated. Yang and Li (2017) describe the interpretation of students' average number sense scores under four headings:

(1) if the students' mean score on the number sense test (msns) is 6≤msns≤8, they refer to high number sense,

(2) if it is, 4.8≤msns<6, they have high-middle number sense,

(3) if 3≤msns<4.8, they have low-middle number sense, and

(4) if 0≤msns<3, they have low number sense.

In this context, the calculated values were grouped and interpreted under four headings.

Table 5. Descriptive values for variables of gender & duration of stay as an immigrant

	Group	Gender	f	$\bar{X}$
C1	Younger group	Female	36	1.18
		Male	35	1.74
		Total	71	2.93
	Older group	Female	43	1.87
		Male	38	3.50
		Total	81	5.37
	Total	Female	79	1.53
		Male	73	2.62
C2	Younger group	Female	36	2.26
		Male	35	2.23
		Total	71	4.49
	Older group	Female	43	2.86
		Male	38	4.11
		Total	81	6.97
	Total	Female	79	2.56
		Male	73	3.17
C3	Younger group	Female	36	1.97
		Male	35	1.85
		Total	71	3.82
	Older group	Female	43	2.08
		Male	38	3.34
		Total	81	5.42
	Total	Female	79	2.03
		Male	73	2.60
C4	Younger group	Female	36	1.51
		Male	35	1.83
		Total	71	3.34
	Older group	Female	43	2.00
		Male	38	2.88
		Total	81	4.88
	Total	Female	79	1.76
		Male	73	2.36
C5	Younger group	Female	36	1.50
		Male	35	1.53
		Total	71	3.03
	Older group	Female	43	1.82
		Male	38	2.78
		Total	81	4.61
	Total	Female	79	1.66
		Male	73	2.16
WTTT-NS	Younger group	Female	36	8.43
		Male	35	9.18
		Total	71	17.61
	Older group	Female	43	10.63
		Male	38	16.62
		Total	81	27.24
	Total	Female	79	9.53
		Male	73	12.90

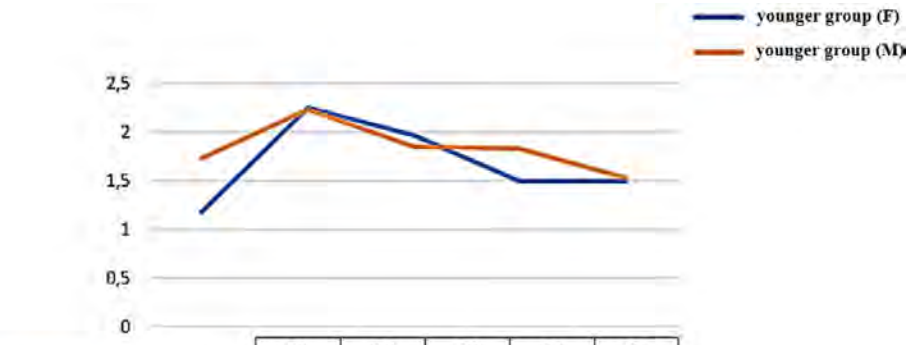
RESULTS

This section presents the results of the analysis on whether the number sense skills of Syrian immigrant students differ by their gender and duration of stay as an immigrant, and the level of the students' conceptual awareness of number sense components.

Differences in Variables of Gender & Duration of Stay as An Immigrant

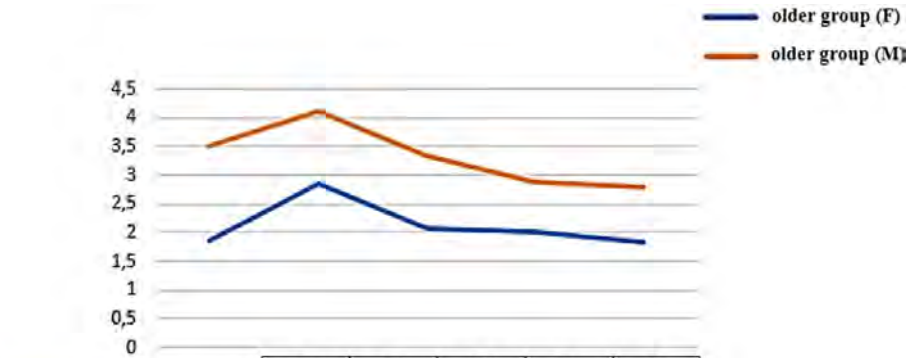
Before determining whether the number sense skills of Syrian immigrant students studying in multicultural environments differ by their gender and duration of stay as an immigrant, the descriptive statistical values of the participants' WTTT-NS general score and number sense component scores were calculated according to their gender and duration of stay. **Table 5** provides the results of the estimated values.

As can be seen in **Table 5**, the male students in the younger group were seen to score higher in the components, namely, understanding the meaning of numbers ($\bar{X}C1=1.74$), recognizing the relative effects of an operation on numbers ($\bar{X}C4=1.83$), and being able to judge the reasonableness of a computational result ($\bar{X}C5=1.53$) when compared to the female students in the younger group; however, on the other hand, they got relatively lower scores in the number sense components including recognizing the relative number size ($\bar{X}C2=2.26$) and using different representations of numbers and operations ($\bar{X}C3=1.97$). Considering the mean



	C1	C2	C3	C4	C5
younger group (F)	1,18	2,26	1,97	1,51	1,5
younger group (M)	1,74	2,23	1,85	1,83	1,53

Figure 6. Comparison by gender in younger group (Source: Authors' own elaboration)



	C1	C2	C3	C4	C5
older group (F)	1,87	2,86	2,08	2	1,82
older group (M)	3,5	4,11	3,34	2,88	2,78

Figure 7. Comparison by gender in older group (Source: Authors' own elaboration)

scores for general number sense in WTTT-NS, it appeared that the mean score of the male students in the younger group was higher than that of the female students in the same group (9.18-8.43).

Figure 6 shows a comparative representation of the mean number sense scores of the students in the younger group for the gender variable. As can be seen in **Figure 6**, the number sense component in which the female and male students in the younger group have the highest average is recognizing the relative number size (C2), whereas those with the lowest average are the component of understanding the meaning of numbers (C1) in female subjects and the component of judging the reasonableness of a computational result (C5) in male subjects.

When the mean scores of the students in the older group were compared within the scope of number sense components, it was determined that male students got higher scores than female ones considering all number sense components.

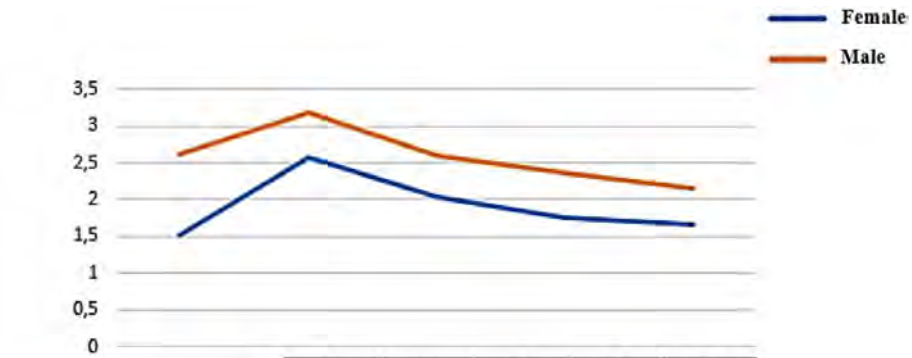
Similarly, when the older group students' mean score for the general number sense in WTTT-NS was considered, it seemed that the mean score of male students was higher than that of the female students (16.62-10.63). **Figure 7** presents a comparative representation of the mean number sense scores of the students in the older group for the gender variable.

As seen in **Figure 7**, the number sense component in which female and male students in the older group have the highest average is recognizing the relative number size (C2), whereas the component with the lowest average is related to judging the reasonableness of a computational result (C5).

When the mean general number sense scores in WTTT-NS and the mean scores of the number sense components were compared within the scope of the genders of the participants, it was found that the male students had higher mean scores in all number sense components than female students. In addition, when the mean general number sense scores in WTTT-NS were analyzed in terms of the gender of the participants, it appeared that the average WTTT-NS score of male students (12.90) was higher than that of female students (9.53).

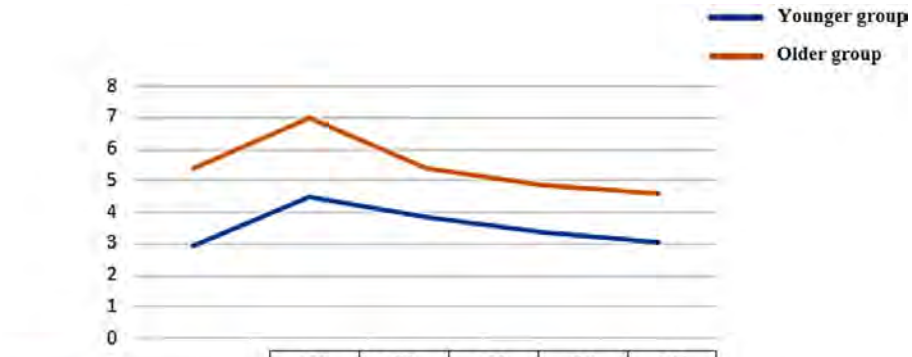
As shown in **Figure 8**, the number sense component in which female and male students have the highest average is recognizing the relative number size (C2), while those with the lowest average comprise understanding the basic meaning of numbers in female subjects (C1) and being able to judge the reasonableness of a computational result in male participants (C5).

Table 5 provides data in terms of the duration of stay as an immigrant, and it can be seen that the students in the older group had higher mean scores in the subcomponents including understanding the meaning of numbers (5.37-2.93), recognizing the relative number size (6.97-4.49), using different representations of numbers and operations (5.42-3.82), recognizing the effects of operations on numbers (4.88-3.34), and being able to judge the reasonableness of a computational result (4.61-3.03), when



	C1	C2	C3	C4	C5
Female	1,53	2,56	2,03	1,76	1,66
Male	2,62	3,17	2,6	2,36	2,16

Figure 8. Mean scores in number sense component by gender variable (Source: Authors' own elaboration)



	C1	C2	C3	C4	C5
younger group	2,93	4,49	3,82	3,34	3,03
older group	5,37	6,97	5,42	4,88	4,61

Figure 9. Mean scores in number sense component by variable of duration of stay as an immigrant (Source: Authors' own elaboration)

compared to those of the students in the younger group. The analysis of the mean scores for the general number sense in WTTT-NS in relation to the duration of students' stay as immigrants has indicated that the average number sense score of the students in the older group (27.24) was higher than that of those in the younger group (17.61) on average.

Figure 9 shows a comparative representation of the average number sense scores of the participants in relation to the variable of duration of stay as an immigrant. As shown in **Figure 9**, the students in the younger and older groups have the highest average in recognizing the relative number size of the number sense component (C2), whereas they have the lowest average in the component called understanding the meaning of numbers in the younger group (C1) and judging reasonableness or a computational result in the older group. (C5).

Prior to determining whether the differences, which were found in line with the analysis of the data, were significant or not, the normality of the data set was examined within the scope of the variables of gender and duration of stay as an immigrant, as a result of which the data was found to have a normal distribution. Thus, the results were evaluated with the *t*-test for independent samples. The results of this evaluation are provided in **Table 6** and **Table 7**.

Based on the results of independent samples t-test, which was conducted to determine how the number sense skills of Syrian immigrant students studying in multicultural environments differed in terms of gender and duration of stay as an immigrant, the following findings were obtained: Considering the gender variable, the students in the younger group did not present a significant difference in relation to number sense components and WTTT-NS, whereas those in the older group showed a statistical significance in the following components: (C1) understanding the meaning of numbers ($t[61.75]=-4.284$, $p<0.05$), (C2) recognizing the relative number size ($t[79]=-3.479$, $p<0.05$), (C3) being able to use different representations of numbers and operations ($t[79]=-4.011$, $p<0.05$), (C4) recognizing the relative effects of an operation on numbers ($t[79]=-3.716$, $p<0.05$), and (C5) being able to judge the reasonableness of a computational result ($t[79]=-3.041$, $p<0.05$), as well as WTTT-NS scores ($t[71.13]=-5.974$, $p<0.05$).

When the group differences among Syrian immigrant students are not taken into account, it is clear that the components, namely, (C1) understanding the basic meaning of numbers ($t[121.33]=-4.258$, $p<0.05$), (C2) recognizing the relative number size ($t[139.07]=-2.5$, $p<0.05$), (C3) being able to use different representations of numbers and operations ($t[150]=-2.735$, $p<0.05$), (C4) recognizing the relative effects of an operation on numbers ($t[150]=-3.518$, $p<0.05$), (C5) being able to judge the reasonableness of a computational result ($t[139.98]=-2.418$, $p<0.05$), and overall WTTT-NS scores ($t[126.36]=-4.893$, $p<0.05$) show a significant difference according to gender. On the other hand, considering the variable of the duration of stay as an immigrant, Syrian immigrant students' scores for the components, namely, (C1) understanding the meaning of numbers ($t[144.6]=-3.245$, $p<0.05$),

Table 6. Independent samples t-test results for variable of gender

	Group	Category	f	$\bar{X}$	t	df	p
C1	Younger group	Female	36	1.18	-1.831	69.00	0.710
		Male	35	1.74			
	Older group	Female	43	1.87	-4.284	61.75	**0.000**
		Male	38	3.50			
	Total	Female	79	1.53	-4.258	121.33	**0.000**
		Male	73	2.62			
C2	Younger group	Female	36	2.26	-0.087	69.00	0.931
		Male	35	2.23			
	Older group	Female	43	2.86	-3.479	79.00	**0.001**
		Male	38	4.11			
	Total	Female	79	2.56	-2.500	139.07	**0.014**
		Male	73	3.17			
C3	Younger group	Female	36	1.97	0.203	69.00	0.840
		Male	35	1.85			
	Older group	Female	43	2.08	-4.011	79.00	**0.000**
		Male	38	3.34			
	Total	Female	79	2.03	-2.735	150.00	**0.007**
		Male	73	2.60			
C4	Younger group	Female	36	1.51	-1.304	69.00	0.197
		Male	35	1.83			
	Older group	Female	43	2.00	-3.716	79.00	**0.000**
		Male	38	2.88			
	Total	Female	79	1.76	-3.518	150.00	**0.001**
		Male	73	2.36			
C5	Younger group	Female	36	1.50	-0.236	69.00	0.814
		Male	35	1.53			
	Older group	Female	43	1.82	-3.041	79.00	**0.003**
		Male	38	2.78			
	Total	Female	79	1.66	-2.418	139.98	**0.017**
		Male	73	2.16			
WTTT-NS	Younger group	Female	36	8.43	-1.123	69.00	0.265
		Male	35	9.18			
	Older group	Female	43	10.63	-5.974	71.13	**0.000**
		Male	38	16.62			
	Total	Female	79	9.53	-4.893	126.36	**0.000**
		Male	73	12.90			

Note. α=0.05

(C2) recognizing the relative number size (t[149.98]=-2.618, p<0.05), (C4) being able to use different representations of numbers and operations (t[149.99]=-2.28, p<0.05), (C5) being able to judge the reasonableness of a computational result (t[148.38]=-2.034, p<0.05), and the general WTTT-NS scores (t[136.48]=-3.89, p<0.05) show a statistically significant difference according to the variable of the duration of stay as an immigrant; however, the score for the component, namely, (C3) being able to use different representations of numbers and operations (t[149.92]=-1.798, p>0.05) show no statistically significant difference according to the duration of stay as an immigrant.

The effect sizes of the differences in relation to the variables were calculated by using t values (Green & Salkind, 2005, p. 169). For interpreting the calculated effect size values, Green and Salkind (2005, p. 169) suggested that the d=0.2 be considered a small effect size, 0.5 a medium effect size, and 0.8 and above a large effect size. For this reason, we decided to evaluate the effect sizes calculated in the study as "0<d≤0.2 small, 0.2<d<0.8 medium and 0.8≤d<… large". **Table 8** provides data on the calculated effect size values for the detected differences.

Table 7. Independent samples t-test results for variable of duration of stay as an immigrant

	Category	f	$\bar{X}$	t	df	p
C1	Younger group	71	1.53	-3.245	144.60	**0.001**
	Older group	81	2.62			
C2	Younger group	71	2.56	-2.618	149.98	**0.010**
	Older group	81	3.17			
C3	Younger group	71	2.03	-1.798	149.92	0.074
	Older group	81	2.60			
C4	Younger group	71	1.76	-2.280	149.99	**0.024**
	Older group	81	2.36			
C5	Younger group	71	1.66	-2.034	148.38	**0.044**
	Older group	81	2.16			
WTTT-NS	Younger group	71	9.53	-3.890	136.48	**0.000**
	Older group	81	12.90			

Note. α=0.05

Table 8. Calculated effect size values regarding detected differences

	Group	Category	f	t	*D*	*d* interpretation
C1	Older group	Female	43	-4.284	0.95	Large
		Male	38			
	Student	Female	79	-4.258	0.69	Medium
		Male	73			
	Student	Younger group	71	-3.245	0.56	Medium
		Older group	81			
C2	Older group	Female	43	-3.479	0.77	Medium
		Male	38			
	Student	Female	79	-2.500	0.40	Medium
		Male	73			
	Student	Younger group	71	-2.618	0.42	Medium
		Older group	81			
C3	Older group	Female	43	-4.011	0.89	Large
		Male	38			
	Student	Female	79	-2.735	0.44	Medium
		Male	73			
C4	Older group	Female	43	-3.716	0.82	Large
		Male	38			
	Student	Female	79	-3.518	0.57	Medium
		Male	73			
	Student	Younger group	71	-2.280	0.37	Medium
		Older group	81			
C5	Older group	Female	43	-3.041	0.67	Medium
		Male	38			
	Student	Female	79	-2.418	0.39	Medium
		Male	73			
	Student	Younger group	71	-2.034	0.33	Medium
		Older group	81			
WTTT-NS	Older group	Female	43	-5.974	1.33	Large
		Male	38			
	Student	Female	79	-4.893	0.79	Medium
		Male	73			
	Student	Younger group	71	-3.890	0.63	Medium
		Older group	81			

Note. α=0.05

The calculated effect sizes indicate that the gender variable has a large effect considering the students in the older group in relation to the following components: (C1) understanding the meaning of numbers, (C3) being able to use different representations of numbers and operations, (C4) recognizing the relative effects of an operation on numbers, and WTTT-NS, while it has a medium effect on the components of (C2) recognizing the relative number size and (C5) being able to judge the reasonableness of a computational result. Moreover, when the group difference between Syrian immigrant students is not considered, it seems that the effect of the gender variable is medium when evaluated in the scope of number sense components and WTTT-NS.

On the other hand, considering the duration of stay as an immigrant, it has been determined that the said variable leads to a medium effect in terms of number sense components of (C1) understanding the meaning of the numbers, (C2) recognizing the relative number sizes, (C4) recognizing the relative effects of an operation on numbers, and (C5) being able to judge the reasonableness of a computational result in the context of WTTT-NS.

Table 9. Awareness levels of students in scope of WTTT-NS

	Group	Category	Gender	f	%	$\bar{X}$
WTTT-NS	Low number sense	Younger group	Female	34	94.44	1.67
			Male	29	82.86	1.69
			Total	63	88.73	1.68
		Older group	Female	38	88.37	1.59
			Male	16	42.11	2.13
			Total	54	66.67	1.75
		General	Female	72	91.14	1.63
			Male	45	61.64	1.85
	Low-moderate number sense	Younger group	Female	2	5.56	3.70
			Male	6	17.14	3.44
			Total	8	11.27	3.51
		Older group	Female	5	11.63	4.03
			Male	19	50.00	4.07
			Total	24	29,63	4.06
		General	Female	7	8.86	3.94
			Male	25	34.25	3.92
	High-moderate number sense	Younger group	Female	-	0.00	0.00
			Male	-	0.00	0.00
			Total	-	0.00	0.00
		Older group	Female	-	0.00	0.00
			Male	3	7.89	4.98
			Total	3	3.70	4.98
		General	Female	-	0.00	0.00
			Male	3	4.11	4.98

Table 10. Correct answer distributions in scope of WTTT-NS

	Category	Gender	C1 (f)	C2 (f)	C3 (f)	C4 (f)	C5 (f)	General (f)
WTTT-NS	Younger group	Female	28	59	48	38	37	210
		Male	43	52	48	46	38	227
		Total	71	111	96	84	75	437
	Older group	Female	45	68	53	50	46	262
		Male	80	90	73	70	64	377
		Total	125	158	126	120	110	639

Students' Conceptual Awareness of Number Sense Components

This section provides information about the awareness levels of Syrian immigrant students about the concept of number sense as a result of calculating the average number sense scores they had in WTTT-NS in addition to the types of reasons they gave in WTTT-NS related to number sense components. **Table 9** shows the distribution of the students' mean scores for the number sense in line with WTTT-NS.

The number sense awareness levels of the students regarding their mean scores for the number sense in WTTT-NS were found to be distributed in the range of low number sense, low-moderate number sense, and high moderate number sense levels, whereas no student seemed to have reached the high number sense level.

Based on these findings, it is clear that most of the female students in the younger group were (94.44%) at the low number sense, while 5.56% of them were at a low-moderate number sense level. Similarly, male students in the younger group were found to have a high percentage (82.86%) of low number sense, while 17.40% had a low moderate number sense.

The examination of the number sense awareness levels of the female students in the older group reveals that although they were mostly at the low number sense level (88.37%), they were at the low-moderate number sense level at a percentage of 11.63%. Contrary to these comparisons, the male students in the older group were mostly found to have low-moderate number sense (50.00%) and low number sense (42.11%), in addition to the high-moderate number sense at the rate of 7.89%.

When the group-based differences between Syrian immigrant students are not considered, it appears that the female students' number sense awareness level was higher (91.14%) while their low-moderate number sense level was much lower (8.86%). Similarly, the male students were found to have low number sense, low-moderate number sense, and high-moderate number sense at the percentages of 61.64%, 34.25%, and 4.11%, respectively.

Considering the Syrian immigrant students' duration of stay as an immigrant, it seemed apparent that the students in the younger and older groups presented a low number sense level with a high percentage (88.73%-66.67%) and a low-medium number sense level with a lower percentage (11.27%-29.63%). In addition, unlike the students in the younger group, it seems that the students in the older group had a high-moderate number sense at a rate of 3.70%. **Table 10** gives data on the distribution of the correct answers given by the students in the first stage of WTTT-NS in terms of gender and duration of stay as an immigrant.

As shown in **Table 10**, the most correct answers of the female and male students in the younger and older groups are gathered in the component of recognizing the relative number size. It can also be seen that the number sense components that the students gave the least correct answers were that of understanding the meaning of numbers for the female students in the younger and

Table 11. Reasons given by students in scope of WTTT-NS

Reasoning stage	Group	Gender	C1 (f-%)	C2 (f-%)	C3 (f-%)	C4 (f-%)	C5 (f-%)	WTTT-NS (%)
Number sense based	Younger group	Female	12-42.86	23-38.98	20-41.67	11-28.95	13-35.14	37.62
		Male	14-32.56	24-46.15	17-35.42	13-28.26	12-31.58	35.24
		Total	26-36.62	47-42.34	37-38.54	24-28.57	25-33.33	36.38
	Older group	Female	18-40.00	33-48.53	18-33.96	14-28.00	15-32.61	37.40
		Male	41-51.25	54-60.00	38-52.05	16-22.86	30-46.88	47.48
		Total	59-47.20	87-55.06	56-44.44	30-25.00	45-40.91	43.35
	General	Female	30-41.10	56-44.09	38-37.62	25-28.41	28-33.73	37.50
		Male	55-44.72	78-54.93	55-45.45	29-25.00	42-41.18	42.88
Rule based	Younger group	Female	8-28.57	9-15.25	9-18.75	15-39.47	9-24.32	23.81
		Male	14-32.56	11-21.15	6-12.50	19-41.30	12-31.58	27.31
		Total	22-30.99	20-18.02	15-15.63	34-40.48	21-28.00	25.63
	Older group	Female	12-26.67	12-17.65	13-24.53	23-46.00	11-23.91	27.10
		Male	17-21.25	17-18.89	28-38.36	49-70.00	16-25.00	33.69
		Total	29-23.20	29-18.35	41-32.54	72-60.00	27-24.55	30.99
	General	Female	20-27.40	21-16.54	22-21.78	38-43.18	20-24.10	25.64
		Male	31-25.20	28-19.72	34-28.10	68-58.62	28-27.45	31.29
Mis-conception	Younger group	Female	4-14.29	17-28.81	10-20.83	4-10.53	10-27.03	21.43
		Male	9-20.93	11-21.15	9-18.75	4-8.70	9-23.68	18.50
		Total	13-18.31	28-25.23	19-19.79	8-9.52	19-25.33	19.91
	Older group	Female	8-17.78	6-8.82	6-11.32	2-4.00	11-23.91	12.60
		Male	14-17.50	15-16.67	4-5.48	0-0.00	15-23.44	12.73
		Total	22-17.60	21-13.29	10-7.94	2-1.67	26-23.64	12.68
	General	Female	12-16.44	23-18.11	16-15.84	6-6.82	21-25.30	16.53
		Male	23-18.70	26-18.31	13-10.74	4-3.45	24-23.53	14.90
Guessing	Younger group	Female	4-14.29	10-16.95	9-18.75	8-21.05	5-13.51	17.14
		Male	6-13.95	5-9.62	16-33.33	10-21.74	5-13.16	18.50
		Total	10-14.08	15-13.51	25-26.04	18-21.43	10-13.33	17.85
	Older group	Female	7-15.56	17-25.00	16-30.19	11-22.00	9-19.57	22.90
		Male	8-10.00	4-4.44	2-2.74	4-5.71	3-4.69	5.57
		Total	15-12.00	21-13.29	18-14.29	15-12.50	12-10.91	12.68
	General	Female	11-15.07	27-21.26	25-24.75	19-21.59	14-16.87	20.34
		Male	14-11.38	9-6.34	18-14.88	14-12.07	8-7.84	10.43

older groups and judging the reasonableness of a computational result for the male students in the younger and older groups. When the correct answers are examined within the scope of WTTT-NS, it can be seen that the male students in both the younger and older groups had more correct answers than the female students in the same groups. When the correct answers were analysed in relation to the number sense components, it appeared the students in the younger and older groups gave more correct answers to the component of recognizing the relative number size than they did to the other components. Furthermore, the number sense components that the students answered least correctly were that of understanding the meaning of numbers in the younger group and judging the reasonableness of a computational result in the older group.

Given the correct answers provided by the students in the first stage of WTTT-NS, the descriptive values of the types of reasons they gave in the justification stage, which is described as the second stage, are given in **Table 11**.

Within the scope of WTTT-NS, the findings regarding the types of reasons given by the students in the second stage have revealed that the female students in the younger and older groups and the male students in the older group preferred number sense based solutions more than other solutions in the following components: understanding the meaning of numbers, recognizing the relative number size, being able to use different representations of numbers and operations, and being able to judge the reasonableness of a computational result, whereas they seemed to have preferred the rule-based solutions more in the component of recognizing the relative effects of an operation on numbers, a result, which is similar to that of the male students in the younger group.

In addition, the male students in the younger group were seen to have preferred number sense-based solutions in the components of recognizing number dimension and being able to use different representations of numbers and operations, while preferring number sense and rule-based solutions in understanding the meaning of numbers and being able to judge the reasonableness of a computational result, when compared to other solutions.

When the students are evaluated according to their gender within the scope of number sense components, the male students seem to have preferred number sense-based solutions more than female students did in the components of understanding the meaning of numbers, recognizing the relative number size, being able to use different representations of numbers and operations, and being able to judge the reasonableness of a computational result, whereas the female students turned out to have preferred the number sense-based solutions more than male students in the component of recognizing the relative effects of an operation on numbers. In WTTT-NS, it was seen that male students preferred the number sense and rule-based solutions more than female students did, while female students preferred prediction-based solutions and misconceptions.

When the students were compared in terms of their duration of stay as an immigrant, the students in the older group were detected to have preferred number sense-based solutions more than the students in the younger group did in the components of

understanding the meaning of numbers, recognizing the relative number size, being able to use different representations of numbers and operations, and being able to judge the reasonableness of a computational result. In WTTT-NS, the students in the older group seem to have preferred number sense and rule-based solutions more than the students in the younger group, while the preferences of those in the younger group for the misconception and prediction-based solutions outnumber the rates of those in the other group.

DISCUSSION, CONCLUSIONS, & RECOMMENDATIONS

This study aimed to determine to what extent the number sense skills of Syrian immigrant students studying in multicultural and middle socio-economic secondary schools differ by their gender and duration of stay as an immigrant, in addition to the extent of the students' conceptual awareness of the number sense components within the scope of the determined variables. For this purpose, the students were administered a two-tier WTTT-NS, as a result of which the obtained data were analysed in terms of the variables of gender and duration of stay as an immigrant.

First, the general mean scores for the number sense skills of Syrian immigrant students considering the impact of the gender variable showed that the mean score of male students ($\bar{X}^{younger}_{WTTT\text{-}NS}$=9.18, $\bar{X}^{older}_{WTTT\text{-}NS}$=16.62) in the younger and older groups was higher than that of the female students ($\bar{X}^{younger}_{WTTT\text{-}NS}$=8.43, $\bar{X}^{older}_{WTTT\text{-}NS}$=10.63) in the same groups. Considering the number sense mean scores of the students in the younger group on the basis of components, male students were found to have higher scores in the components of understanding the meaning of numbers ($\bar{X}^{M,F}_{C1}$=1.74-1.18), recognizing the relative effects of an operation on numbers ($\bar{X}^{M,F}_{C4}$=1.83-1.51), and being able to judge the reasonableness of a computational result ($\bar{X}^{M,F}_{C5}$=1.53-1.50), whereas the female students turned out to have higher scores in the components of recognizing the relative number size ($\bar{X}^{F,M}_{C2}$=2.26-2.23) and being able to use different representations of numbers and operations ($\bar{X}^{F,M}_{C3}$=1.97-1.85). In a similar manner, when compared, the number sense mean scores of the students in the older group indicate that male students scored higher in all number sense components than female students did. Whether or not the differences in gender variable were significant was evaluated with the independent samples t-test to reveal that gender factor did not have an effect in the younger group, but it proved an influential factor in the older group. When the students' duration of stay as an immigrant is not considered, the gender variable appears to be moderately influential and statistically significant in favour of males in the whole WTTT-NS and number sense components. Within the relevant literature, there are many studies (Akkaya, 2016; Aunio et al., 2004, 2006; Birgin & Peker, 2022; Boonen et al., 2011; Reys & Yang, 1998) reporting that the gender variable does not show a significant difference in relation to number sense. Contrary to this context, there are also other studies (Jordan et al., 2006; Sahin, 2019; Singh, 2009) showing that male students scored higher than female students, indicating similarity to the results of the present study. To attain such a result, some factors are thought to play an active role, including

(1) male immigrants living in the camps outnumber their female peers in pre-school and primary school levels (Peterson, 2011),

(2) male immigrants start working life at a younger age compared to females (Aksoy, 2020), and

(3) female immigrants get married at an earlier age (Zlotnik, 1995).

However, the female students in the younger group scored higher than the male students in the same group in the component of recognizing the relative number size and being able to use different representations of numbers and operations, though there was no significant difference in these results. Considering that these results coincide with the studies of Yang et al. (2007, 2008), it can be assumed that the success of female students with immigrant status will increase provided that the problems they encounter such as access to education, early marriage, language difference, and social cohesion (Association for Human Rights and Solidarity for Asylum Seekers, 2014, p. 5) are eliminated, and their classroom climate will be likely to be positively affected accordingly.

Similarly, when the students' general mean scores for the number sense and number sense components measured in WTTT-NS are examined in relation to the extent to which the number sense performances of the students differ by the duration of stay as an immigrant, it seems that the mean number sense scores of the students who have a longer duration with an immigrant status in Turkey are higher than those who have a shorter immigrant status. When the significance of this difference for the variable of the duration of stay as an immigrant is evaluated, it can be concluded that the difference in WTTT-NS and in all components except the component of using different representations of numbers and operations have a significant and moderate effect in favour of the older group. Such differences are similar to the findings of some studies conducted by Akkaya, (2016), Aunio (2006, p. 29), Aunio et al. (2006), Chen et al. (2015), Pittalis et al. (2018), and Sing (2009) who have stated that as the grade level or age increases, the number sense performance of individuals will increase, despite the fact that they differ with the study conducted by Mohamed and Johnny (2010). In addition, the result of Petersson's (2018) study in which immigrant students and local students (new immigrants have higher performance compared to old immigrants) were compared also differs from the current study results. As the reasons for such results, it can be suggested that the students who have stayed in Turkey as an immigrant for a longer time when compared to those who have for a shorter time, seem to

(1) have overcome the language problem, which is considered as an obstacle to academic achievement (Hoff, 2013),

(2) have handled some educational issues such as old-new conflict, peer adjustment problems, and financial difficulties (Belhadj Kouider et al., 2014),

(3) have developed a sense of belonging to school (Uwah et al., 2008), as well as their social (Amiot et al., 2015) and cultural identities (Reddy & van Dam, 2020), which have positively been influenced over time, and

(4) have solved the problems they experience faster in terms of acculturation process (Berry, 2005).

When evaluated in terms of number sense components, the best performances of the students turned out to be in the component of recognizing the relative number size (25.55%), with their lowest performance being in the component of being able to judge the reasonableness of a computational result (17.03%). In support of this result, Akkaya (2016), Reys and Yang (1998), and Yang et al. (2008) also reported that the most successful number sense component among the participants in their studies was that of recognizing the relative number size. However, Can and Yetkin Ozdemir (2020) stated that students have difficulties with the topic of fractions in their study and stated that the component of recognizing the relative number size, where the highest success has been achieved in the current study, represents the lowest success in their studies. It is also clear that the number sense component in which the students in the current study had the lowest success, appeared in some studies in the literature (Yang & Li, 2008; Yang & Sianturi, 2020). However, contrary to this result, Akkaya (2016) emphasized that the most difficult component of number sense for students is the one related to the ability to use different representations of numbers and operations. The reasons for such a difference in performance can be evaluated by suggesting that:

(1) the students perform operations by considering the part-whole relationship in the comparison or ordering of numbers (Yang & Li, 2008) and

(2) the students who have problems in linguistic competence also have problems in cognitive skills (Videsott et al., 2012).

In WTTT-NS, though the average number sense scores of the female students in both groups were considerably lower than those of the male students ($\%^{F,M}_{younger}$=94.44-82.86; $\%^{F,M}_{older}$=88.37-42.11), the female students were also found to have low-intermediate number sense levels at a lower rate ($\%^{F,M}_{younger}$=5.56-17.14; $\%^{F,M}_{older}$=11.63-50). However, it was observed that only the male students ($\%^{M}_{older}$=7.89) in the older group were able to reach the high-intermediate number sense level. When the group differences are not considered in these comparisons, it turns out that the female students ($\%^{F}_{WTTT\text{-}NS}$=91.14; $\%^{M}_{WTTT\text{-}NS}$=61.64) had significantly much lower number sense compared to the male students, and low-middle number sense ($\%^{F}_{WTTT\text{-}NS}$=8.86; $\%^{M}_{WTTT\text{-}NS}$=34.25) and high-middle number sense at a low rate ($\%^{F}_{WTTT\text{-}NS}$=0.00; $\%^{M}_{WTTT\text{-}NS}$=4.11). As can be seen from these results, the length of time students stay in Turkey creates notable differences in their number sense performance, but it still does not change the fact that most of the students are at a low level. In the literature, for example, the general number sense success rate was reported as 46.00% by Yang et al. (2008), 34.00% by Yang and Li (2008), 20.00% by Yang and Lin (2015), 24.00%-30.00% by Akkaya (2016); there are a number of other studies (Caglar, 2021; Markovits & Sowder, 1994; Reys et al., 1999; Verschaffel et al., 2007; Yapici & Kayhan Altay, 2017) whose results were in parallel with those of the current study. On the other hand, Chen et al. (2015) examined the number sense performances among 4th, 5th, and 6th grade local students, recent immigrants, and those with low socioeconomic levels in Taiwan, finding that new immigrant students in 6th grade had better number sense performances compared to other students. Having examined the relationship between poverty and the academic achievement of students in immigrant families, Zhang and Han (2017) stated that immigrant students outperformed local students from a certain poverty status.

Considering the types of reasons preferred by the students in the second stage of WTTT-NS by taking into account the variable of gender, it seems clear that number sense-based solutions were preferred at the highest rate in the component of recognizing the relative number size (25.00%), in addition to rule-based solutions in the component of recognizing the relative effects of an operation on numbers (34.00.%), misconception-based solutions in the component of being able to judge the reasonableness of a computational result (31.00%), and guessing as a solution in the component of being able to use different representations of numbers and operations (27.00%). It appeared that while the male students mostly preferred number sense and rule-based solutions, female students preferred solutions based on misconception and guessing. Similarly, the students with a longer stay as an immigrant in Turkey are predominantly larger in number in the context of number sense and rule-based solutions, while those with a shorter duration of stay as an immigrant turned out to prefer misconception and estimation-based solutions. In addition, the reason why Syrian immigrant students preferred number sense-based solutions more than other solutions in WTTT-NS is one of the surprising results of this study, and it should be noted that most students have a low level of number sense. Compared to these results, a number of studies (Almeida et al., 2016; Kayhan Altay, 2010; Yapici, 2013) have found that rule-based solutions are preferred due to rote-learning, while Caglar (2021) and Chen et al. (2015) have reported that misconception-based solutions are predominant in their studies. However, the fact that Caglar (2021) and Yang and Cheung (2020) stated that number sense-based solutions are dominant in the component of recognizing the relative number size in their studies, being similar to the results obtained in the current study. Moreover, the reason for the number sense and rule-based solutions being dominant in the older group can be assumed to be their longer interaction with the mathematics course (Chen et al., 2015), while the reason why these solutions are found at a high rate among male students is thought to stem from the fact that male immigrants start their business life at a younger age compared to female ones (Aksoy, 2020), enabling them to practice arithmetic operations.

Considering the results of the study, despite the low number sense performance of immigrant students, that they prefer number sense-based solutions more than other solutions in response reasons is different from previous studies (Almeida et al., 2016, Caglar, 2021; Chen et al., 2015; Kayhan Altay, 2010; Yapici, 2013). Nevertheless, the limited number of studies in the literature conducted on the number sense performance of immigrant students makes it difficult to generalize these results. In addition, students who are faced with some difficulties such as language, education and financial problems in the countries they migrate should be given more learning opportunities compared to their peers, and the mathematics curriculum should be revised in line with this purpose. What is more, students who are faced with some difficulties such as language, education and financial problems in the countries they migrate to should be given more learning opportunities compared to their peers, and the mathematics curriculum should be revised in line with this purpose. Students' low number sense performance is also attributed to teachers' low competencies in teaching the number sense (Almeida et al., 2016; Tsao & Lin, 2012; Yang et al., 2008). For that reason, we believe that the classroom climate will be positively affected by virtue of in-service trainings to be provided for teachers. It is also known that another critical factor affecting the in-class performance of students is the family factor (Maulbeck, 2021; Takeuchi,

2016; Zamora, 2015). In this respect, it can be suggested that student-family harmony should be improved by conducting studies emphasizing how the number sense performances of students are affected by the family factor, thereby facilitating the integration of immigrants into society. Finally, it can be recommended that future researchers conduct studies investigating how to provide the opportunity to ensure that immigrant individuals learn the number sense in order to improve their academic performance, what kind of teaching method should be integrated, and the compatibility of the teaching materials used in this process.

Author contributions: Both authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Ethical statement: The authors stated that the study was approved by the Kilis 7 Aralik University Ethics Committee on 3 January 2023 with approval number 2023/01. Written informed consents were obtained from the participants.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

Akkaya, R. (2016). An investigation into the number sense performance of secondary school students in Turkey. *Journal of Education and Training Studies, 4*(2), 113-123. https://doi.org/10.11114/jets.v4i2.1145

Aksoy, E. (2020). Syrian immigrant children's schooling status in Turkey. *Academic Elegance Journal, 7*(14), 37-51.

Almeida, R., Bruno, A., & Perdomo-Díaz, J. (2016). Strategies of number sense in pre-service secondary mathematics teachers. *International Journal of Science and Mathematics Education, 14*(5), 959-978. https://doi.org/10.1007/s10763-014-9601-6

Amiot, C. E., de la Sablonniere, R., Smith, L. G., & Smith, J. R. (2015). Capturing changes in social identities over time and how they become part of the self-concept. *Social and Personality Psychology Compass, 9*(4), 171-187. https://doi.org/10.1111/spc3.12169

Association for Human Rights and Solidarity for Asylum Seekers. (2014). *Kamp dışında yaşayan Suriyeli kadın sığınmacılar raporu* [*Report on Syrian women refugees living outside the camps*]. https://istanbul.mazlumder.org/tr/main/yayinlar/yurt-ici-raporlar/3/mazlumder-kampdisinda-yasayan-suriyeli-kadin/1116

Aunio, P. (2006). Number sense in young children–(inter)national group differences and an intervention programme for children with low and average performance. *Helda*. https://helda.helsinki.fi/bitstream/handle/10138/19991/numberse.pdf

Aunio, P., Ee, J., Lim, S. E. A., Hautamäki, J., & Van Luit, J. (2004). Young children's number sense in Finland, Hong Kong and Singapore. *International Journal of Early Years Education, 12*(3), 195-216. https://doi.org/10.1080/0966976042000268681

Aunio, P., Niemivirta, M., Hautamäki, J., Van Luit, J. E., Shi, J., & Zhang, M. (2006). Young children's number sense in China and Finland. *Scandinavian Journal of Educational Research, 50*(5), 483-502. https://doi.org/10.1080/00313830600953576

Bahadir, E. (2021). Ethnomathematics approach in mathematics education for migrant students. *Milli Eğitim Dergisi* [*National Education Journal*], *50*(1), 577-594. https://doi.org/10.37669/milliegitim.959829

Bakalevu, S. (1998). *Fijian perspectives in mathematics education* [Unpublished PhD thesis]. University of Waikato.

Belhadj Kouider, E., Koglin, U., & Petermann, F. (2014). Emotional and behavioral problems in migrant children and adolescents in Europe: A systematic review. *European Child & Adolescent Psychiatry, 23*, 373-391. https://doi.org/10.1007/s00787-013-0485-8

Berry, J. W. (2005). Acculturation: Living successfully in two cultures. *International Journal of Intercultural Relations, 29*(6), 697-712. https://doi.org/10.1016/j.ijintrel.2005.07.013

Birgin, O., & Peker, E. S. (2022). An investigation of 8th grade Turkish students' performance on number sense. *Educational Studies*. https://doi.org/10.1080/03055698.2022.2049593

Boonen, A., Kolkman, M., & Kroesbergen, E. (2011). The relation between teachers' math talk and the acquisition of number sense within kindergarten classrooms. *Journal of School Psychology, 49*, 281-99. https://doi.org/10.1016/j.jsp.2011.03.002

Brilliant, J. J. (2000). Issues in counseling immigrant college students. *Community College Journal of Research and Practice, 24*, 577-586. https://doi.org/10.1080/10668920050139721

Burton, M. (2012). What is math? Exploring the perception of elementary pre-service teachers. *IUMPST: The Journal, 5*.

Caglar, M. (2021). *The study on the relationship between the number sense and mathematical literacy performance of the 8th grade students* [PhD thesis, Bolu Abant Izzet Baysal University].

Can, A. (2023). *Quantitative data analysis in scientific research process with SPSS*. Pegem Academy.

Can, D., & Yetkin Ozdemir, I. E. (2020). An examination of fourth-grade elementary school students' number sense in context-based and non-context-based problems. *International Journal of Science and Mathematics Education, 18*, 1333-1354. https://doi.org/10.1007/s10763-019-10022-3

Chen, P. C., Li, M. N., & Yang, D. C. (2015). A study of number sense performance among low-SES students, new immigrant children, and typical learners in grades four through six. *EURASIA Journal of Mathematics, Science and Technology Education, 11*(3), 455-468. https://doi.org/10.12973/eurasia.2015.1345a

Geva, E., & Benhamu, D. (2020). A culturally sensitive intervention for Syrian refugee children with interrupted schooling: Targeting math vocabulary and associated numbersense skills. *Child and Youth Refugee Research Coalition*. http://hdl.handle.net/10222/79943

Green, S. B., & Salkind, N. J. (2005). *Using SPSS for Windows and Macintosh. Analyzing and undestanding data*. Pearson.

Greeno, J. G. (1991). Number sense as situated knowing in a conceptual domain. *Journal for Research in Mathematics Education, 22*(3), 170-218. https://doi.org/10.5951/jresematheduc.22.3.0170

Hoff, E. (2013). Interpreting the early language trajectories of children from low-SES and language minority homes: Implications for closing achievement gaps. *Developmental Psychology, 49*(1), 4-14. https://doi.org/10.1037/a0027238

Hope, J. (1989). Promoting number sense in school. *Arithmetic Teacher, 36*(6), 12-16. https://doi.org/10.5951/AT.36.6.0012

Howden, H. (1989). Teaching number sense. *Arithmetic Teacher, 36*(6), 6-11. https://doi.org/10.5951/AT.36.6.0006

Jordan, N. C., Kaplan, D., Locuniak, M. N., & Ramineni, C. (2007). Predicting first grade math achievement from developmental number sense trajectories. *Learning Disabilities Research & Practice, 22*(1), 36-46. https://doi.org/10.1111/j.1540-5826.2007.00229.x

Jordan, N. C., Kaplan, D., Nabors Olah, L., & Locuniak, M. N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development, 77*(1), 153-175. https://doi.org/10.1111/j.1467-8624.2006.00862.x

Kayhan Altay, M. (2010). *An investigation of middle grade students? Number sense in terms of grade level, gender and components of number sense* [PhD thesis, Hacettepe University].

Kayhan Altay, M., & Umay, A. (2013). The development of number sense scale towards middle grade students. *Education and Science, 38*(167), 241-255.

Levels, M., Dronkers, J., & Kraaykamp, G. (2008). Immigrant children's educational achievement in western countries: Origin, destination, and community effects on mathematical performance. *American Sociological Review, 73*(5), 835-853. https://doi.org/10.1177/000312240807300507

Markovits, Z., & Sowder, J. (1994). Developing number sense: An intervention study in grade 7. *Journal for Research in Mathematics Education, 25*(1), 4-29. https://doi.org/10.5951/jresematheduc.25.1.0004

Maulbeck, J. (2021). "Not having family as one makes it even harder for my kids to learn:" Understanding benefits of family-based migration. *Journal of International Migration and Integration, 23*(3), 1257-1276. https://doi.org/10.1007/s12134-021-00887-1

McIntosh, A., Reys, B. J., & Reys, R. E. (1992). A proposed framework for examining basic number sense. *For the Learning of Mathematics, 12*(3), 2-8.

MNE. (2018). *Mathematics curriculum.* Ministry of National Education Press Office.

Mohamed, M., & Johnny, J. (2010). Investigating number sense among students. *Procedia-Social and Behavioral Sciences, 8*, 317-324. https://doi.org/10.1016/j.sbspro.2010.12.044

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2004). *SPSS for introductory statistics: Use and interpretation*. Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410610539

NCTM. (2000). *NCTM standards 2000: Principles and standards for school mathematics*. National Council of Teachers of Mathematics.

OECD. (2015). *Helping immigrant students to succeed at school–And beyond*. OECD Publishing.

Paras, J. (2001). Crisis in mathematics education. Student failure: Challenges and possibilities. *South African Journal of Higher Education, 15*(3), 66-73. https://doi.org/10.4314/sajhe.v15i3.25327

Peterson, S. D. (2011). Conflict, education and displacement. *Conflict and Education: An Intedisciplinary Journal, 1*(1), 1-5.

Petersson, J. (2018). Newly- and early-immigrated second-language students' knowledge of arithmetic syntax. *Nordic Studies in Mathematics Education, 23*(3-4), 105-122.

Pittalis, M., Pitta-Pantazi, D., & Christou, C. (2018). A longitudinal study revisiting the notion of early number sense: Algebraic arithmetic as a catalyst for number sense development. *Mathematical Thinking and Learning, 20*(3), 222-247. https://doi.org/10.1080/10986065.2018.1474533

Planas, N., & Valero, P. (2016). Tracing the socio-cultural-political axis in understanding mathematics education. In Á. Gutiérrez, G. H. Leder, & P. Boero (Eds.), *The second handbook of research on the psychology of mathematics education. The journey continues* (pp. 275-313). Sense Publishers. https://doi.org/10.1007/978-94-6300-561-6_13

Reddy, G., & van Dam, R. M. (2020). Food, culture, and identity in multicultural societies: Insights from Singapore. *Appetite, 149*, 104633. https://doi.org/10.1016/j.appet.2020.104633

Reys, R. E., & Yang, D. C. (1998). Relationship between computational performance and number sense among sixth and eighth-grade students in Taiwan. *Journal for Research in Mathematics Education, 29*(2), 225-237. https://doi.org/10.5951/jresematheduc.29.2.0225

Reys, R., Reys, B., McIntosh, A., Emanuelsson, G., Johansson, B., & Yang, D. C. (1999). Assessing number sense of students in Australia, Sweeden, Taiwan, and the United States. *School Science and Mathematics, 99*(2), 61-70. https://doi.org/10.1111/j.1949-8594.1999.tb17449.x

Sahin, G. (2019). *Development number sense in midle school students'* [Master's thesis, Gaziantep University].

Singh, P. (2009). An assessment of number sense among secondary school students. *International Journal for Mathematics Teaching and Learning*.

Takeuchi, M. A. (2016). Parents' involvement in early years mathematics learning: The case of Japanese immigrant parents. In M. B. Wood, E. E. Turner, M. Civil, & J. A. Eli (Eds.), *Proceedings of the 38th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education* (pp. 1115-1118).

Tsao, Y. L., & Lin, Y. C. (2012). Elementary school teachers' understanding towards the related knowledge of number sense. *US-China Education Review, 1*, 17-30.

Uwah, C. J., McMahon, H. G., & Furlow, C. F. (2008). School belonging, educational aspirations, and academic self-efficacy among African American male high school students: Implications for school counselors. *Professional School Counseling, 11*(5), 296-305. https://doi.org/10.1177/2156759X0801100503

Verschaffel, L., Greer, B., & De Corte, E. (2007). Whole number concepts and operations. In F. Lester (ed.), *Second handbook of research on mathematics teaching and learning*. Information Age.

Videsott, G., Della Rosa, P. A., Wiater, W., Franceschini, R., & Abutalebi, J. (2012). How does linguistic competence enhance cognitive functions in children? A study in multilingual children with different linguistic competences. *Bilingualism: Language and Cognition, 15*(4), 884-895. https://doi.org/10.1017/S1366728912000119

Votruba-Drzal, E., Coley, R. L., Collins, M., & Miller, P. (2015). Center-based preschool and school readiness skills of children from immigrant families. *Early Education and Development, 26*(4), 549-573. https://doi.org/10.1080/10409289.2015.1000220

Wahid, S. N. S., Yusof, Y., & Razak, M. R. (2014). Math anxiety among students in higher education level. *Procedia-Social and Behavioral Sciences, 123*, 232-237. https://doi.org/10.1016/j.sbspro.2014.01.1419

Yang, D. C. (1995). *Number sense performance and strategies possessed by sixth and eighth grade students in Taiwan* [Doctoral Thesis, University of Missouri].

Yang, D. C. (2019). Development of a three-tier number sense test for fifth-grade students. *Educational Studies in Mathematics, 101*(3), 405-424. https://doi.org/10.1007/s10649-018-9874-8

Yang, D. C., & Cheung, K. L. (2020). Performance of sixth graders in Hong Kong on a number sense three-tier test. *Educational Studies, 46*(1), 39-55. https://doi.org/10.1080/03055698.2018.1516631

Yang, D. C., & Li, M. (2008). An investigation of 3rd-grade taiwanese students' performance in number sense. *Educational Studies, 34*(5), 443-455. https://doi.org/10.1080/03055690802288494

Yang, D. C., & Lin, Y.C. (2015) . Using calculator-assisted instruction to enhance low-achievers in learning number sense: A case study of two fifth graders in Taiwan. *Journal of Education and Learning, 4*(2), 64-72. https://doi.org/10.5539/jel.v4n2p64

Yang, D. C., & Sianturi, I. (2020). Sixth grade students' performance, misconception, and confidence on a three-tier number sense test. *International Journal of Science and Mathematics Education, 19*(1), 355-375. https://doi.org/10.1007/s10763-020-10051-3

Yang, D. C., & Wu, W. R. (2010). The study of number sense: Realistic activities integrated into third-grade math classes in Taiwan. *The Journal of Educational Research, 103*(6), 379-392. https://doi.org/10.1080/00220670903383001

Yang, D. C., Li, M., & Lin, C.-I. (2008). A study of the performance of 5th graders in number sense and its relationship to achievement in mathematics. *International Journal of Science and Mathematics Education, 6*(4), 789-807. https://doi.org/10.1007/s10763-007-9100-0

Yang, D.C., & Li, M. N. (2017). *A study of fifth graders' performance on the three-tier number sense test* [Paper presentation]. The 41st Annual Meeting of the International Group for the Psychology of Mathematics Education.

Yang, D.C., & Reys, R. E. (1998). Relationship between computational performance and number- sense among sixth- and eighth-grade students in Taiwan. *Journal for Research in Mathematics Education, 29*(2), 225-237. https://doi.org/10.5951/jresematheduc.29.2.0225

Yapici, A., & Kayhan Altay, M. (2017). An investigation of middle school students' number sense regarding percent. *Abant Izzet Baysal University Journal of Faculty of Education, 17*(4), 2221-2243. https://doi.org/10.17240/aibuefd.2017..-337984

Zamora, J. C. (2015). *Mexican immigrants families traditional and non-traditional language and literacy practices at home that prepare children for school in the United States* [PhD thesis, Arizona State University].

Zhang, L., & Han, W. J. (2017). Poverty dynamics and academic trajectories of children of immigrants. *International Journal of Environmental Research and Public Health, 14*(9), 1076. https://doi.org/10.3390/ijerph14091076

Zlotnik, H. (1995). Migration and the family: The female perspective. *Asian and Pacific Migration Journal, 4*(2-3), 253-271. https://doi.org/10.1177/011719689500400205