A Method Based on a Genetic Algorithm for Classroom Seating Arrangements

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Abstract: In this study, we propose a method for determining the classroom seating arrangements considering relationships between one student and the other students sitting around him or her. The method for determining the classroom seating arrangements is constructed based on our proposed genetic algorithm. In order to determine the optimal classroom seating arrangements, the genetic algorithm is applied on the basis of the questionnaire result of how students feel when they take a class on the seats assigned to them and the analysis of each student’s personality. Experiments are carried out in order to verify the effectiveness of the proposed method.

Key Words: classroom seating arrangements, genetic algorithm, matrix crossover, coaching test.

1. Introduction

Classroom seating arrangements are an important topic to discuss because there are many different ways a teacher can arrange the seating in his or her classroom [1]. If a teacher succeeds in his or her classroom seating arrangements, he or she may take control over his or her classes [2]. It is said that classroom seating arrangements are a method for teaching classes well and for improving learning environment for each student [3].

There are mainly three kinds of classroom seating arrangements: desk rows, a circle or semicircle and clusters. The first one, desk rows, is a traditional classroom seating arrangement. A teacher stands in the front of the classroom and all the students’ desks are placed like a matrix and face to the front. The second one, a circle or semicircle, where desks and chairs are arranged in a circle or half circle, is suitable for group discussions. The third one, clusters, where desks are arranged in four or five groups, is very conducive to group learning and group work.

Generally, one of classroom seating arrangements, desk rows, is adopted in Japan. Students receiving a higher education usually select their seats with their intention. On the other hand, in elementary and secondary school, classroom seating arrangements are often determined in order of a student’s ID number at the beginning of the first term to help teachers to memorize the names of students as soon as possible. In this case, first of all, students’ physical features are considered. To be precise, if there are students who cannot hear a teacher’s voice very well or cannot see letters written on the blackboard very well when they take back-row seats in the classroom, they are assigned front-row seats. Thereafter, they are often determined by lot or with a homeroom teacher and students’ intention.

According to previous studies, if students take a lecture by choosing their seats with their intention, students who have front seats behave more appropriately as a student in comparison with other students [4]. If classroom seating arrangements are determined by lot, students who are assigned front seats give more utterances related to the lecture and are more positive about the lecture than ones who are assigned back seats [4]. Many students assigned back seats complain that it is difficult to hear a teacher’s voice and to see letters written on the blackboard [4].

It is found from behavioral studies dealing with personal factors of classroom seating arrangements that students who sit in the action-zone tend to get better grades and higher concentration than students who sit in the other zone [5]. The action-zone is defined as the center of the classroom and the front rows in the classroom [5]. In addition, students sitting on the seats in the action-zone interact better with a teacher in comparison with students sitting on the seats on its periphery [6].

In this study, we propose a method for determining classroom seating arrangements to improve learning environment of all students in the classroom. The problem for determining the classroom seating arrangements is formulated as a combinatorial optimization problem in which relationships between one student and the other students sitting around him or her are considered. If there are forty students, the number of the classroom seating arrangements is the factorial of forty, which is such a huge number that it seems to be difficult to find out the optimal classroom seating arrangements. Therefore, in order to determine the optimal classroom seating arrangements, a genetic algorithm [7] is applied in this study. The genetic algorithm can search for an optimal solution by using procedures which are called the crossover and the mutation. It is known that the genetic algorithm is an effective search method in comparison with other methods [8]. To determine the optimal classroom seating arrangements, it is applied on the basis of the questionnaire result of how students feel when they take a class on the seats assigned to them and the analysis of each student’s personality. In general, the crossover should be designed on the
basis of characteristics of optimization problems. In our problem, since students’ desks are placed like a matrix, we apply the matrix crossover [9] in which a new candidate solution is generated by exchanging a part of the matrix. In order to examine the effectiveness of our proposed method, we compare the classroom seating arrangement determined by the proposed method with that determined in order of a student’s ID number and in consideration for students’ physical features.

2. Classroom Seating Arrangement Problem

Figure 1 shows desk rows. In this figure, D₁, D₂, …, D₁₅ and D₁₆ show desk numbers and slash marks show aisles in the classroom. T₁ shows a teacher’s desk and the blackboard is behind the desk. In higher education, students usually choose their seats with their intention. Each student takes his or her seat in consideration of other students who sit around the seat [1]. Such a choice, however, does not necessarily bring about an improvement in learning environment for students. The same is true of the classroom seating arrangement determined in order of a student’s ID number.

In this paper, classroom seating arrangements are optimized to improve learning environment. This classroom seating arrangement problem is formulated as a combinatorial optimization problem in which relationships between one student and the other students sitting around him or her are considered. The objective function of the problem is defined by using several factors. These factors are classified into two categories. One category consists of individual factors of each student and the other consists of external factors related to one student and the other students sitting around him or her.

2.1 Factors to Define the Objective Function

In the study of seating behavior of university students in the classroom, factors for a student’s choice of seats in the classroom are a distance between a teacher’s desk and a student’s seat, a sense of distance between a seat where one student sits and seats where the other students sit, a student’s eyesight, a student’s hearing, a student’s favorite seat and a student’s interest in a lecture [10]. In this study, the individual factors are frequencies of non-productive talking, a place where a student can hear a teacher’s voice, a place where a student can see letters written on the blackboard, a student’s interest in a subject and the first choice of seats where a student wants to sit.

A questionnaire is carried out to obtain the individual factors in this study. The following is an example of the questionnaire. We use it in our experiments.

1. Do you often have a non-productive talk?
   A (Very often), B (Often), C (Not very often), D (Never)

2. Please show the place in the classroom where you can hear a teacher’s voice.
   A (First row), B (Second row), C (Third row), D (Fourth row), E (Fifth row), F (Sixth row), G (Seventh row), H (Eighth row)

3. Please show the place in the classroom where you can see letters which a teacher writes on the blackboard.
   A (First row), B (Second row), C (Third row), D (Fourth row), E (Fifth row), F (Sixth row), G (Seventh row), H (Eighth row)

4. How much are you interested in electronics and semiconductor engineering?
   A (Very much), B (Much), C (Not very much), D (No)

5. Please show the seat in the classroom where you want to sit?
   A (First row), B (Second row), C (Third row), D (Fourth row), E (Fifth row), F (Sixth row), G (Seventh row), H (Eighth row)

The external factors are the compatibility of personality between one student and the other students sitting around him or her. It is thought that students learn from each other and improve their ability in the classroom, and that some combinations between one student and the other students sitting around him or her help the student to improve his or her ability, and others prevent the student from improving it. It is necessary to know each student’s personality to determine the combination to help to improve his or her ability. The coaching test is adopted to obtain the personality because it is considered that the classification in the coaching test is effective in this study.

The coaching test classifies a student’s personality into four types: a controller type (C), a promoter type (P), a supporter type (S) and an analyzer type (A) [11]. Students belonging to the controller type are active, tend to perform a lot of work according to their own thought, and, above all, they dislike instructions from other students. Students belonging to the promoter type are fond of challenges to carry out new things, but they are lacking in vitality. Students belonging to the supporter type like to assist other students. They are cooperative and consider human relationships first. Students belonging to the analyzer type are fond of collecting and analyzing information, but they are weak in changes and confusion.

2.2 Formulation of the Problem

Let us formulate the classroom seating arrangement problem. We have p students \( \{i; i = 1, 2, \ldots, p\} \), where \( p \) is the number of students, and indicate their seats, which are placed like \( n \times m \) matrix. A solution \( x \) for the problem is a classroom seating arrangement for the students. The objective function \( V_i \), which concerns the individual factors of student \( i \), is given by

\[
V_i = \sum_{m=1}^{5} \beta_{im} a_{im}
\]

where \( a_{im} \) is a score of the individual factors of student \( i \) and is determined from the student’s answer to the questionnaire.
mentioned above, and $\beta_m$ is a weight. In our experiments, $a_{i1}$ shows the score as to whether student $i$ often has a non-productive talk, and if student $i$ often has a non-productive talk, $a_{i1}$ becomes a small value. $a_{i2}$ and $a_{i3}$ show the scores as to whether student $i$ can hear a teacher’s voice and as to whether student $i$ can see the letters which a teacher writes on the blackboard, respectively. $a_{i4}$ shows the score of student $i$’s interest in a subject and $a_{i5}$ shows the score as to which seat student $i$ wants to sit on.

The score $a_{im}$ of each individual factor is obtained from the answer of student $i$ to the questionnaire. We explain how to obtain the score by using the questionnaire in Section 2.1. The alternatives in the questionnaire, A, B, C, D, E, F, G and H are defined as grade 1, 2, 3, 4, 5, 6, 7 and 8, respectively. The minimum of the grade is 1 in all questions. The maximum of $a_{im}$ is given by normalizing the grade as follows

$$a_{im} = \frac{A_{im} - A_{min}}{A_{max} - A_{min}},$$

where $A_{im}$ is student $i$’s grade in the $m$-th question, and $A_{min}$ and $A_{max}$ are the maximum and minimum in the $m$-th question, respectively.

$a_{i1}, a_{i2}, a_{i3}, a_{i4}$ and $a_{i5}$ vary according to a teacher’s teaching method, a teacher’s voice quality, the size of letters which a teacher writes on the blackboard, a student’s interest in a subject, and seats where a student wants to sit in the classroom. In addition, the values of $a_{i2}, a_{i3}$ and $a_{i4}$ except the values of $a_{i1}$ and $a_{i5}$ fluctuate between 0.0 and 1.0 during the genetic algorithm calculation.

The objective function $W_i$, which concerns the external factors of student $i$, is given by

$$W_i = \sum_{k=1}^5 a_{ik}(i_{max}, k_{max})W_{ik},$$

where $S_i$ shows students sitting around student $i$. $S_i$ is explained in detail later. $a_{ik}(i_{max}, k_{max})$ is a weight, and $W_{ik}$ is the ID number of $P_{ij}$ and a maximum value of $P_{ik}$. $P_{ij}$ and $P_{ik}$ denote the scores of four types of personality of student $i$ and student $k$, respectively. $i(j = 1, 2, 3, 4)$ represent C, P, S and A, respectively. The type which has the maximum value of each student’s values of the four types is defined as his or her personality. The value of each student’s personality obtained by the coaching test is normalized in the range of 0.0 to 1.0. Equation (3) is considered to find out the combination of one student (student $i$) and one of the other students sitting around student $i$ (student $k$) which helps to improve students’ ability and learning environment. Therefore, the value of student $i$’s personality is given by $max_P P_{ij},$ that of student $k$’s personality is given by $max_P P_{kj},$ and $max_P P_{ij}$ and $max_P P_{kj}$ are added together. $W_{ik}$ is a summation of these two values.

The weight depends on student $i$’s and student $k$’s personalities. $i_{max}$ and $k_{max}$ in (3) are given by

$$i_{max} = \arg \max_{j=1,2,3,4} P_{ij},$$

$$k_{max} = \arg \max_{j=1,2,3,4} P_{kj},$$

where $i_{max}$ and $k_{max}$ represent student $i$’s personality and student $k$’s personality, respectively. A value of the weight $a_{ik}(i_{max}, k_{max})$ is determined according to the compatibility between student $i$’s and student $k$’s personalities. An example of value is shown in Table 1 in Section 4.1 and explained in detail in the section. $a_{ik}(i_{max}, k_{max})$ is multiplied by $W_{ik}$ to show an affinity between student $i$ and student $k$.

We explain $S_i$ in detail. A definition of students who sit around student $i$ is shown below. Let $n_{xy}$ be the ID number of the student who sits on the seat in the $x$-th row and the $y$-th column. The first equation in (8) shows ID numbers of three students: one student sitting in front of student $i$, $S_{up}$ shows students sitting in back of student $i$, $S_{down}$ shows students sitting on the left of student $i$, and $S_{right}$ shows students sitting on the right of student $i$.

Equations (8), (9), (10) and (11) show $S_{ap}, S_{down}, S_{left}$ and $S_{right}$, respectively. We explain (8) in detail. Figure 2 shows four areas of the seat where student $i$ sits in the case of (8). In this figure, desks are arranged in $m$ rows and $n$ columns. The first equation in (8) shows ID numbers of three students: one student sitting in front of student $i$ and the other two students sitting on both sides of the student in front of student $i$, when student $i$ sits in A in Fig. 2. The second equation in (8) shows ID numbers of two students: one student sitting in front of student $i$ and the other student sitting on the right of the student in front of student $i$, when student $i$ sits in B in Fig. 2. The third equation in (8) shows ID numbers of two students: one student sitting in front of student $i$ and the other student sitting on the left of the student in front of student $i$, when student $i$ sits in C in Fig. 2. The fourth equation in (8) shows that there are no students in front of student $i$ when student $i$ sits in D in Fig. 2.
Step 2 Pick up two candidate solutions, \( x_1 \) and \( x_2 \), randomly from the current population, and remove them from the current population.

Step 3 Generate two new candidate solutions, \( x_3 \) and \( x_4 \), from \( x_1 \) and \( x_2 \) according to a procedure called the matrix crossover. \( x_1 \) and \( x_2 \) are called parents, and \( x_3 \) and \( x_4 \) are called children. In the matrix crossover, children are generated by inheriting the classroom seating arrangement based on parents partially.

Step 4 Generate a new candidate solution \( x_5 \) by changing a part of \( x_1 \). Similarly, generate another new candidate solution \( x_6 \) by changing a part of \( x_2 \). \( x_3 \) and \( x_4 \) are generated by a procedure called the mutation.

Step 5 Select the two best candidate solutions from the six candidate solutions \( \{x_1, x_2, \cdots, x_6\} \) and add them to the population.

Step 6 If \( g = TG \), terminate this algorithm and output the best candidate solution as the answer. If not, set \( g \leftarrow g + 1 \) and return to Step 2. The parameter \( TG \) is given in advance.

3.1 Chromosome

A chromosome in the genetic algorithm corresponds to a candidate solution, and it should be encoded adequately. In the proposed genetic algorithm, a chromosome corresponds to a classroom seating arrangement in which each student is assigned one of the \( m \times n \) desks. The chromosome is represented by permuting ID numbers of students and forming them into \( m \times n \) matrix. The number at the \( i \)-th row and the \( j \)-th column means the ID number of the student who is assigned the desk at the same position in the classroom.

3.2 Crossover and Mutation

The crossover and the mutation are two basic procedures of the genetic algorithm. In this study, we adopt the matrix crossover [9]. The first child \( (C_1) \) is made by doing the following procedure: first of all, a submatrix is randomly selected in the first parent \( (P_1) \); secondly, the chromosome of \( P_1 \) except the submatrix is copied to the first child \( (C_1) \); finally, the chromosome of the second parent \( (P_2) \) is scanned and if the number which \( C_1 \) does not have is found, it is added to the vacant submatrix of \( C_1 \). The second child \( (C_2) \) is made by doing the same procedure as \( C_1 \).

Figure 3 shows \( P_1 \) and \( P_2 \). \( P_1(p,q) \) is a submatrix of \( P_1 \). Figure 4 shows \( C_1 \). \( C_1(p,q) \) is a submatrix of \( C_1 \). The chromosome of \( C_1 \) except \( C_1(p,q) \) is a copy of the chromosome of \( P_1 \) except \( P_1(p,q) \). The chromosome of \( C_1(p,q) \) is selected from \( P_2 \). In detail, first of all, the numbers in \( P_2 \) are scanned one by one from the first row and the first column through the \( m \)-th row and the \( n \)-th column. When the number which \( C_1 \) except \( C_1(p,q) \) does not have is found, it is added to the first row and the first column of \( C_1(p,q) \). Similarly, when another such number is found, it is added to the first row and the second column of \( C_1(p,q) \). This procedure is repeated until all such numbers are added to \( C_1(p,q) \).

Mutation plays an important part in the genetic search to pre-
vent the population from stagnating at local optima. In this study, we adopt the exchange mutation. We explain the exchange mutation in detail. The first mutation individual (M1) is made as follows: two numbers belonging to the first parent (P1) are selected randomly and they are exchanged. The second mutation individual (M2) of the second parent (P2) is made by doing the same procedure as (M1).

4. Experimental Results

In this section, first of all, we explain the weight values of the objective function \( W_i \). Secondly, we state the computational results which are brought by using the genetic algorithm proposed to find out the optimal classroom seating arrangements. Finally, we provide a detailed description of the experiment which is carried out in the classroom to verify the effectiveness of the computational results.

4.1 The Weight Values of the Objective Function \( W_i \)

The values of the weight \( a_i(k_{\text{max}}, k_{\text{max}}) \) in (3) are shown in Table 1. 1, 2, 3 and 4 represent \( C, P, S \) and \( A \), respectively, in Table 1. For example, if student \( i \) and student \( k \) are a controller type, it is thought that an interaction between them may not occur because they dislike instructions from each other. That is why \( a_i(k_{\text{max}}, k_{\text{max}}) = 0.10 \). If they are a supporter type, there is a strong possibility that an interaction between them will occur because they are cooperative. That is why \( a_i(k_{\text{max}}, k_{\text{max}}) = 1.00 \). If they are an analyzer type, there is a strong possibility that an interaction between them will occur because they are fond of collecting and analyzing information. That is why \( a_i(k_{\text{max}}, k_{\text{max}}) = 1.00 \). If one of them is a supporter type and the other is an analyzer type, there is a strong possibility that an interaction between them will occur because one of them is cooperative and the other is fond of collecting and analyzing information. That is why \( a_i(k_{\text{max}}, k_{\text{max}}) = 1.00 \). The other weight values are assigned in the range of 0.25 to 0.75 by 0.25 according to the compatibility between their personalities.

4.2 The Computational Results

The proposed method is applied to the classroom seating arrangement problem. In this case, real data are used. Participants are thirty-six students at a national institute of technology in Japan. They are classmates and have a similar educational background. They have also been following the same curriculum for two years, and it is thought that their human relationships are very fine. First of all, we carry out the questionnaire mentioned in Section 2 and the coaching test in order to obtain \( a_{ik} \) and \( P_{ij} \). As for the problem setting, \( \beta_{ik} \) in (1) is set at one, and \( \gamma \) in (12) is also set at one. Secondly, the classroom seating arrangements are determined by using the genetic algorithm. In our genetic algorithm, there are two parameters: the population size \( (PS) \) and the final generation \( (FG) \). Their values are decided through a preliminary calculation as follows:

<table>
<thead>
<tr>
<th>( k_{\text{max}} ) = 1</th>
<th>( k_{\text{max}} = 2 )</th>
<th>( k_{\text{max}} = 3 )</th>
<th>( k_{\text{max}} = 4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.50</td>
<td>0.75</td>
<td>0.25</td>
</tr>
<tr>
<td>0.50</td>
<td>0.75</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>0.25</td>
<td>0.75</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 1 Weight values in equation (3).

The genetic algorithm is performed ten times with various random seeds to evaluate an average performance. Table 2 shows the computation time and the value of the objective function obtained by the genetic algorithm. It is found that the classroom seating arrangement is determined in a short time because even the value of computation time for \( FG = 100,000 \) is 1002 seconds. It is confirmed from this table that the genetic algorithm for \( FG = 100,000 \) is better than that for \( FG = 10,000 \), because the value of the objective function for \( FG = 100,000 \) is larger.

Table 3 The computational results of \( W_i \).

<table>
<thead>
<tr>
<th>( FG )</th>
<th>10,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>( W_{\text{min}} )</td>
<td>0.55</td>
<td>0.53</td>
</tr>
<tr>
<td>( W_{\text{max}} )</td>
<td>2.79</td>
<td>2.45</td>
</tr>
<tr>
<td>( W_{\text{ave}} )</td>
<td>1.06</td>
<td>1.08</td>
</tr>
<tr>
<td>( \sigma_{w} )</td>
<td>0.382</td>
<td>0.344</td>
</tr>
</tbody>
</table>

\( W_{\text{min}} \): Minimum value of \( W_i \).  
\( W_{\text{max}} \): Maximum value of \( W_i \).  
\( W_{\text{ave}} \): Average value of \( W_i \).  
\( \sigma_{w} \): Standard deviation of \( W_i \).

\( PS = 50, FG = 10,000 \) or \( 100,000 \).

In order to verify the effectiveness of the computational result, we compare the classroom seating arrangement obtained by the genetic algorithm with that determined in order of a student’s ID number and in consideration for students’ physical features. The experiment is carried out at a national institute of technology in Japan. Participants are the thirty-six students mentioned in Section 4.2. At the beginning of the first term every year, the classroom seating arrangement of their class is determined in order of a student’s ID number and in consideration for students’ physical features to help teachers to memorize the names of the students as soon as possible.

First of all, the students take a class on the seats which are arranged in order of a student’s ID number and in consideration for students’ physical features for approximately one hundred
Fig. 5 The classroom seating arrangement based on the proposed genetic algorithm ($FG = 100,000$).

minutes. Secondly, the students take a class on the seats determined by the genetic algorithm for approximately one hundred minutes. After the class, they fill out a questionnaire on those two classroom seating arrangements. Finally, we analyze the result.

The questionnaire is as follows:

1. Is there anyone whom you can talk with about your questions around you in the second class?
   A (Yes), B (No)

2. Do you have the seat where you want to sit in the second class?
   A (Yes), B (A seat near the seat), C (No)

3. Can you hear a teacher’s voice better in the second class than in the first class?
   A (Much better), B (A little better), C (About the same as in the first class), D (A little worse), E (Much worse)

4. Can you see letters written on the blackboard better in the second class than in the first class?
   A (Much better), B (A little better), C (About the same as in the first class), D (A little worse), E (Much worse)

5. Are the students quieter in the second class than in the first class?
   A (Much quieter), B (A little quieter), C (About the same as in the first class), D (A little noisier), E (Much noisier)

6. Can you concentrate on the second class?
   A (Much better), B (A little better), C (About the same as in the first class), D (A little worse), E (Much noisier)

7. Are you more satisfied with your seat in the second class than in the first class?
   A (Much more), B (A little more), C (About the same as in the first class), D (A little less), E (Much less)

8. How do you feel about your seat determined by the genetic algorithm in the second class in comparison with the seat determined in order of a student’s ID number and in consideration for students’ physical features in the first class?
   A (Much better), B (A little better), C (About the same as in the first class), D (A little worse), E (Much worse)

Table 4 shows the result of the questionnaire. In this table, the first column shows the numbers of the questions in the questionnaire and the other columns show what percentage of students choose each alternative. It is found from the first question that 54.0% of the students have a student whom they can talk with about their questions. In the second question, 73.0% (11.0 + 62.0)% of the students are able to have the seat where they want to sit or a seat near the seat. In the third question, since 92.0% (34.0 + 27.0 + 31.0)% of the students choose A, B or C, it is thought that they are able to hear a teacher’s voice better than or as well as in the first class. In the fourth question, 88.0% (34.0 + 19.0 + 35.0)% of the students reply that they are able to see the letters which a teacher writes on the blackboard better than or as well as in the first class.

The fifth, sixth and seventh questions are unrelated to the objective function in (12). These questions are used to survey the atmosphere of the classroom and the satisfaction levels of the students with the classroom seating arrangement. In the fifth question, 100.0% (31.0 + 38.0 + 31.0)% of the students feel the classroom is quieter than or as quiet as in the first class. In the sixth question, 92.0% (12.0 + 15.0 + 65.0)% of the students feel they are able to concentrate on the class better than or as well as in the first class. In the seventh question, 69.0% (4.0 + 19.0 + 46.0)% of the students are more satisfied with their seats obtained by the genetic algorithm than or as much satisfied as with their seats in the first class; however, 31.0% (16.0 + 15.0)% of the students are less satisfied with their seats obtained by the genetic algorithm. Some improvements will be necessary in this point. In the eighth question, about their seats determined by the genetic algorithm, 81.0% (19.0 + 27.0 + 35.0)% of the students feel better than or as good as about their seats in the first class.

From the questionnaire result, it is found that the students are quieter, can hear the teacher’s voice better, can see the letters written on the blackboard better, and can concentrate on the class better when they take a class on the seats determined by the genetic algorithm in comparison with the seats determined in order of a student’s ID number and in consideration for students’ physical features. Therefore, it is thought that our proposed method for determining the classroom seating arrangements is effective and helps to improve learning environment.

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5. Conclusion

In this paper, we have proposed a method for determining the classroom seating arrangements to improve learning environment of all students in the classroom. The genetic algorithm is applied to find out the optimal classroom seating arrangements. The objective function of the classroom seating arrangement
problem is defined based on the individual factors of each student and an affinity between one student and the other students sitting around him or her.

In order to evaluate the performance of the proposed method, we carried out the experiments. Students take classes on the seats determined in order of a student’s ID number and in consideration for students’ physical features, and then on the seats determined by our proposed method. From the result of the comparison between these two cases, it is found that the classroom seating arrangement determined by our proposed method is more highly endorsed than that determined in order of a student’s ID number and in consideration for students’ physical features because the students are quieter, can hear the teacher’s voice better, can see the letters written on the blackboard better, and can concentrate on the class better when they take a class on the seats determined by our proposed method. Therefore, it is confirmed that the proposed method, which enables a complicated calculation including the individual and external factors, is effective.

In conclusion, our proposed method helps to improve learning environment and can determine the classroom seating arrangements by a simple process in a short time. When teachers make classroom seating arrangements to improve learning environment, this method is useful and its high evaluation by the teachers who use this method will be expected. Our future aim is to investigate a greater number of instances by using our proposed method and validate the effectiveness of the method.

References