# The Impact of Homogeneous vs. Heterogeneous Collaborative Learning Groups in Multicultural Classes on the Achievement and Attitudes of Nine Graders towards Learning Science

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## ABSTRACT

**The current study aims at investigating the impact of homogeneous versus heterogeneous collaborative learning grouping in multicultural classes on the students' achievements and attitudes towards learning science. In the present study, heterogeneity was unpacked through two dimensions: the cultural background, represented by the different nationalities present in the class and the students' different abilities. The interaction between these two factors and their combined effect on the achievement and attitudes were also investigated. The study also considered an approach to provide quality teaching for a diverse group of students by neutralizing the heterogeneity factor or reducing its negative effect.**

**For this purpose, 100 nine graders from more than 10 countries in an independent preparatory school in Doha / Qatar were divided into four classes and distributed over the following learning "STAD" groups:**

- **a- Heterogeneous by ability but homogeneous by nationality.**
- **b- Heterogeneous by nationality but homogeneous by ability.**
- **c- Entirely heterogeneous (i.e. by both the ability and the nationality).**
- **d- Entirely homogeneous (i.e. by both the ability and the nationality).**

**A diagnostic placement test, standardized pretest and posttest in addition to the regular school tests were used to measure the achievement of the students. A Questionnaire was developed to measure the attitudes of the students towards learning science as well as towards group working.**

**The study concluded that the main effects of group structure on the students' attitudes towards learning science were demonstrated by the heterogeneous group. It affected all the attitude components except the "working with students from different cultural backgrounds" dimension, where nearly all group types had the same effect. However, this positive attitude was enhanced when the effect of mixed ability classes was combined with the effect of multiculturalism. Having foreign students or students from different cultures in a mixed ability class, yielded the best desired results. Therefore, the researcher highly recommends maximizing the heterogeneity in a class in all possible ways. The implemented collaborative learning strategy made learning more fun and beneficial for the students, enhanced their self confidence, academic awareness, and consequently their overall attitude towards science.**

**The heterogeneity factor had a negative effect on the achievement of the students. The students in the mixed ability classes scored less than the students in other groups. However, when the "same ability" groups contained students from different cultural backgrounds, the results were the most favorable.**

**The optimum class composition that may yield best achievement results and constructs positive attitudes is a compromise that maximizes group diversity and prevents individual isolation. The interaction between the two factors (ability + multiculturalism) gives the best desired results. In multicultural classes, collaborative learning should be supported by a multicultural education program, otherwise it would have little if any positive effect on the students achievement and attitudes towards learning science.**

**Introduction and background**

**Qatar, one of the greatest economies in the Arabian Gulf is witnessing a rapid development in different state industries. One of which is the educational revolutionary reforms and the bold initiative, Education for a New Era, sponsored and adopted by Her Highness Shiekha Moza, the consort of the Emir of Qatar.**

**To fulfill the requirements of this initiative "Education for a new Era", the Supreme Education Council (SEC) was established by an Emiri decree in Nov 2002 with a major goal to provide the learners with high quality educational experiences and to implement a lifelong learning for all students. The Qatar education reform initiative reflects four principles: autonomy, accountability, variety and choice. To implement the education reform, the SEC established a number of government-funded Independent Schools over a multi-year period and implements annual assessments to measure student learning and school performance.**

**Even though the SEC exerts large efforts and attempts to ensure that school materials and human resources are allocated equitably across schools; the SEC policies and provisions applied to the independent schools had resulted in a considerable variation among schools (for example, each school is free to develop its own curriculum, textbooks and other learning resources). These variations are recorded in the schools' report cards developed by the SEC.**

**However, because of its high level living standards, Qatar has become a favorable place to live and work for hundreds of thousands of skillful manpower coming from all over the world. This has rendered the Qatari society and consequently the schools' environment into a multicultural heterogeneous one.**

**Therefore, in the present study, we decided to investigate the effects of this heterogeneous students' body structure on nine graders' performance and attitudes towards Science in Hamza Independent School, Doha - Qatar. The study also attempted to set a mechanism that might help in creating harmony among a diverse group of students.**

**Literature Review**

**Long time ago Ballard (1915) has stated that *"Another factor unfavorable to progress is the non-recognition of the essential heterogeneity of a collection of children… If they appear like one another today, they will appear unlike one another tomorrow."* It is the composite and complex structure of our world that continuously generates the heterogeneity among any community of learners providing them with different experiences and reflections. A critical factor in the success of any education process is the wise utilization of this diversity to provide quality teaching.**

**One of the most stable characteristics of any group of learners, whether they are adults or children, is its heterogeneity or diversity. It is an inseparable feature of the different experiences the students demonstrate during their learning of a particular topic and it is manifested and can be unpacked across many dimensions. Among the factors that add to heterogeneity are the students previous achievement levels whether high, average, low or gifted, the skills they have gained before, their families, and wider affiliations, culture and heritages.**

**Life experiences, prior educational opportunities, genders, learning styles and personalities of the students create "multiculturalism" (Dunn et al., 2003). Moreover, individuals of the same community may still have cultural differences among them due to their different personal experiences, a matter that is reflected on their self perception, attitudes and relationships with others. This makes it vital to investigate how cultural perspectives would affect the performance of the students and how to create harmony among them.**

**Alton-Lee and Nuthell (1998) have defined Quality teaching as 'pedagogical practices that facilitate for heterogeneous groups of students their access to information, and ability to engage in classroom activities and tasks in ways that facilitate learning related to curriculum goals'. In another study, Alton-Lee (2003) stated that heterogeneity of class groupings is not a fixed characteristic as careful observation of the students indicates that the differences between them are rather fluid and changing and have different ramifications for each new teaching situation accordingly quality teaching is necessarily a response to heterogeneous groups of students.**

**The heterogeneous structure of the students body was identified as one of the major sources of inter-schools (between schools) variation that can significantly affect the students performance and achievement levels.**

**Nowadays, there is no obvious consensus in the literature about the magnitude of the significant role of the school effects imposed by the students' heterogeneous structure on the academic achievement of the**

**students. Some researches indicate that the impact of school characteristics on students' academic performance is of great interest (Greenwald, Hedges, and Laine, 1996). While others have concluded that there is a little or no evidence of a relationship between school factors and student achievement (Hanushek, 1986; 1989),**

**Among the most important studies that analyzed the effects of the school factors, the student body structure, on the students achievement are By Lloyd Thomas, John Wills Lloyd and Edward J (2007); J.R. Lockwood and Daniel F (2008); Vincent Dupriez, Xavier Dumay, and Anne Vause (2008).**

**Coleman (1966) was the first who analyzed the correlation between school heterogeneity and student academic achievement. In doing so, he used the national probability samples of elementary and secondary students to estimate education production functions in order to quantify the association between students' academic performance in standardized tests and school and family input measures. One of the key findings of the Coleman Report was that when the socioeconomic background of the students was held fixed, the differences among schools accounted "for only a small fraction of differences in pupil achievement" (Coleman et al., 1966, p. 21). In other words, variations in school characteristics were not closely associated with, and had hardly any effect on variations in student achievement (Konstantopoulos, 2005).**

**Peterson and Llaudet (2007) in their recent research about the Effects of Heterogeneity on Student Performance have concluded that student socioeconomic status and ethnicity have noticeably larger impacts in reading for black, hispanic, and for those with lower initial test scores and lower socioeconomic status. On the other hand, public schooling was found to have a positive impact on the math scores of Utah-graders who are white or Asian as well as those who have higher initial test scores and come from families of higher socioeconomic status.**

**In the 1990's, multicultural education has emerged in the United States to address the educational needs of a society that continues to struggle with the realization that it is not monocultural, but is an amalgamation of many cultures (Hanley, 1999).**

**Banks (1994, 1997) has identified five dimensions of multicultural education, these are: content integration, knowledge construction, prejudice reduction, equity pedagogy, and creation of empowering school cultures.**

**James Banks (2001) defined multicultural education as, "an idea, an educational reform movement, and a process" (p. 2): As an idea, multicultural education seeks to create equal educational opportunities for**

**all students, including those from different racial, ethnic, and social-class groups. Multicultural education tries to create equal educational opportunities for all students by changing the total school environment so that it will reflect the diverse cultures and groups within society and within the nation's classrooms. Multicultural education is a process because its goals are ideals that teachers and administrators should constantly strive to achieve.**

**The Center for Multicultural Education at the University of Washington and the Common Destiny Alliance at the University of Maryland had formed a Multicultural Education Consensus Panel whose members are specialists in race relations and multicultural education. The Multicultural Education Consensus Panel had described 12 essential principles that are ways to improve educational policies and practices in light of diversity. Improving the academic achievement and intergroup skills were in the focus of the principles (Banks et al., 2001).**

**Higbee and her colleagues at the University of Minnesota had demonstrated that although the existence of a diverse student body can assist students from historically underrepresented populations in feeling that they are not "alone" at the institution, diversity without multiculturalism provides an empty promise. In their work published in 2007, they emphasized the necessity to integrate multiple perspectives in our daily work to create the required welcoming and safe learning environments (Higbee et al., 2007).**

**The multicultural classroom may at first be uncomfortable and challenging to both teachers and students. However, managed well, it can provide the richest of environments for learning, both to students and teachers. It can be a major factor in helping students adjust to a new culture, and be successful in school (Dunn et al., 2003).**

**Because of its remarkable characteristics, collaborative learning (CL), can serve a good method to reduce the heterogeneity effect and create a harmony within a heterogeneous body structure and consequently affect the achievement and the attitudes of learners. According to the National Institute for Science Education, CL is defined as an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. Collaborative learning is based on the idea that learning is a naturally social act in which the participants talk among themselves. It is through the talk that learning occurs (Srinivas, 2009). CL is characterized by developing a relationship among learners that requires positive interdependence, individual accountability (each participant has to contribute and learn), interpersonal skills (communication, trust, leadership, decision making, and conflict resolution), face-to-face promotive interaction, and processing (reflecting on how well the team is functioning and how to function even better).**

**Group work and team building were identified as critical factors in raising awareness about multiculturalism, improving students self perception and enhancing multicultural education. For instance, in their paper titled "Promoting multicultural understanding through team building" and submitted at the 2nd Peace as a Global Language Conference held in Tokyo, Japan on Sept 27-28, 2003, Fazilah and Zuraidah stated that there are many benefits that a school can obtain from turning to team building, of which teams are more creative and more efficient at solving problems and teams generally make higher-quality decisions than individuals. For them, teams are coordinated groups of individuals organized to work together to achieve a specific, common goal. However, Beebe and Masterson (2000) have given a more precise and technical definition for the "team" that can be applied to a multicultural society: "a team refers to members of different ethnic groups either from an organization or different organizations coming together to work on a task and filling in for one another without any feelings of resentment and apprehension" (Cited by Fazilah and Zuraidah, 2003). It is evident from this definition that cultural awareness and being sensitive in dealing with others' cultural sensitivities are crucial factors in developing the relationship with the others. Beebe and Masterson (2000) also stated that "a group with diverse backgrounds, including ethnic diversity, results in better quality ideas. With more information available, the group is more likely to discuss all sides of an issue and is also more likely to arrive at a better solution". (Beebe and Masterson, 2000: p. 12 cited by Fazilah and Zuraidah, 2003).**

**Many researchers had thoroughly studied the impacts of homogeneous and heterogeneous grouping on the attitude and achievement of talented, gifted, high achievement, low achievement and at risk students. There is no obvious consensus among the researchers about the optimum group composition, whether it should be homogeneous or heterogeneous. Cooper, 1990; Johnson, *et al.*, 1998; Nurrenbern, 1995; Slavin, 1995 believe that when possible the group composition should be heterogeneous. On the other hand Felder, *et al.*, 1995; Rosser, 1997; Sandler 1996 contradict this disposition (Cited by Jacob, 1997). However, whenever collaborative learning is implemented in the classroom, careful instruction techniques play a critical factor in the success of the teaching strategy. It can either isolate some members of the group by assigning certain roles to them like a recorder or a presenter or it can get all the group members actively involved (Jacob, 1997). Moreover, forming heterogeneous groups of students from different ethnic groups generates a fear of getting some members of the group isolated. It seems that there is no clear answer to this question. However, a compromise that maximizes group diversity and prevents individual isolation might be to cluster at least two students of common ethnicity in each group (Jacob, 1997).**

**Group work can be applied in different ways: Student Teams – Achievement Divisions (STAD) (Slavin, 1994); Teams – Games Tournament (TGT) (DeVries and Slavin, 1987); Jigsaw (Aronson et al., 1978); Learning Together (Johnson et al., 1987) and Group Investigation (Sharan et al., 1989).**

**Johnson et al. (1992) had divided the learning groups into three types: formal learning groups, informal learning groups and base learning groups. Table 1 summarizes the advantages and the disadvantages of the different ways in which students can be grouped in collaborative learning (Krifik et al., 2007).**

| Method | Advantages | Considerations |
|---|---|---|
| **Student self-selection** | - students choose who to work with | - students overlooked or rejected<br>- inequity in skill distribution<br>- inequity in task distribution |
| **Selective appointment: Groups formed on the basis of criteria i.e. mark aspirations, meeting times, complementary skills, specific competencies** | - students have common goals<br>- less pressure on low achievers<br>- student skills recognized and rewarded as being proficient<br>- appreciation of diversity required in group work | - low achievers not exposed to higher expectations<br>- friends with shared aspirations not accepting a newcomer<br>- less opportunity to develop new skills in unfamiliar roles |
| **Random selection** | - opportunity for students to learn from new people<br>- opportunity to enhance communication skills | - students resent lack of choice<br>- student concern about skills and attitudes of other students |
| **Selection of topic choices** | - students interested in topic<br>- students working with interested others | - inequity in skill distribution<br>- student concern about skills and attitudes of other students |

**Table 1: Group Selection Options (Krifik et al. 2007).**

**Liora et al. (1998) examined the relationship between ability grouping, mathematics achievement, and teacher and student attitudes. They**

**reported that lower-and intermediate level students' achievement was found to be higher in the mixed-ability (MA) setting, and there would be no difference in the higher-level students' achievement.**

**Rosenbaum (1980) and Slavin (1987) analyzed the best controlled studies published since 1960 and reported that for each study exhibiting a net gain in achievement, a comparable study recorded a net loss (for all ability levels except the lowest, which had slightly more losses than gains). Three studies found that high achievers benefit from ability grouping, whereas low achievers suffer; but three others found just the opposite. Kulik and Kulik (1987) found very small effects for comprehensive grouping and moderate, positive effects for programs designed especially for talented students. Gamoran and Berends (1987) found that the academic achievement of gifted students declined when they were placed in heterogeneous classes (Cited by Shields, 1996).**

**The questions of the study and its Assumptions**
**From reviewing the literature and considering the performance of the students in the state standardized tests, we realized that teaching needs to be responsive and accommodated to diversity within the present ethnic groups, for example, diversity within Arabs, Iranian, Pakistani and other students. We also need to consider the diversity within individual students influenced by intersections of cultural heritage(s), socio-economic background, talent and achievement. Teaching that is responsive to student diversity can have very positive impacts on low and high achievers at the same time. Therefore, we started posing the following questions:**

1. ***What are the impacts of homogeneous versus heterogeneous collaborative learning groups on the performance of high achievement nine graders in science?***

2. ***What are the impacts of homogeneous versus heterogeneous collaborative learning groups on the performance of low and intermediate achievement nine graders in science?***

3. ***What is the effect of homogeneous versus heterogeneous collaborative learning groups on the attitudes of high achievement nine graders towards science?***

4. ***What is the effect of homogeneous versus heterogeneous collaborative learning groups on the attitude of nine graders towards learning science?***

5. ***Is the effect of homogeneous versus heterogeneous groups merely a function of the school subject itself or it is influenced by the whole school environment?***

**Worth noting that students' heterogeneity in this study is unpacked through two dimensions: the nationality of the students and their achievement. However, the purpose of the study was not to determine which nationalities perform better than others or have more positive attitudes but rather to determine the effects of having mixed nationality classes on the students' performance and attitude.**

**Based on questions (1-4), the following three questions were branched:**

1. ***Are there any statistically significant differences in the students' achievement in the Pre-test and Post-test?***

2. ***Are there any statistically significant differences in the students' achievement due to the group type?***

3. ***Are there any statistically significant differences in the students' attitude due to the group type?***

**Hypothesis Formulation**

**The researchers suggest that the different nationalities of the students present in the classroom along with their diverse abilities should play a critical role in their performance in the national and regular school tests as well as in forming their personalities, experiences and consequently their attitudes towards the school subjects. Therefore, the following hypotheses were formulated and tested:**

***1- There are statistically significant differences in the students achievement means in the pretest and posttest at α = 0.05.***

***2- There are statistically significant differences in the students achievement means at α = 0.05 due to the group type.***

***3- There are statistically significant differences in the students attitudes towards learning science at α = 0.05 due to the group type.***

**Objectives**

1- **To test if the use of homogeneous versus heterogeneous group would affect the achievement of nine grader high achievers in science in Hamza school.**
2- **To test if the use of homogeneous versus heterogeneous group would improve the achievement of nine grader low and medium achievers in science in Hamza school.**
3- **To test if the use of homogeneous versus heterogeneous group would affect the attitude of nine grader high achievers towards science in Hamza school.**

4- To test if the use of homogeneous versus heterogeneous group would affect the attitude of nine grader low and medium achievers towards science in Hamza school.

## The Long Term Objectives

The long term objective of this study is to determine whether the students' heterogeneous structure makes a difference on overall students performance and attitude towards the school and to set out an approach to eliminate or reduce any negative effects of this factor as well as to provide a diverse group of students with high quality teaching. Therefore, for the current study, the following long term objectives were determined:

1. To test if the Whole School Approach (WSA) implemented in Hamza school would create homogeneity among the nine graders.
2. To test if the use of the WSA would improve the students' achievement in Science among nine graders in Hamza school?
3. To test the effect of WSA on students attitudes towards school.
4. To develop a school program that aids in creating harmony among the students.

## The Significance of the Study

The Qatar Comprehensive Educational Assessments (QCEA) revealed a discrepancy between the academic achievements of the schools in mathematics, language arts (Arabic and English) as well as in sciences. There are many reasons behind this variation; one of them is the school factor or the school effects including the composition of the students' body structure.

Unfortunately, there are no previous studies that aim at finding the relationship between the students' demographically diverse structure and their achievement and attitudes in Qatar. Moreover, neither the Qatar comprehensive assessment implemented by the Qatari Supreme Education Council (SEC) nor the international tests (PIZZA, TIMSS) provide us with reference data that may help in highlighting this issue. Such tests do not consider nationality, ethnic group, mother language or any other factors of diversification in their reports therefore no direct evidence can be inferred.

This study comes to throw some light on this problem by investigation the interactions between the nationality and ability of the students and the effect of that on the students' achievements and attitudes. Hopefully it can initiate a series of serious researches aiming at deeper investigation of this problem and at a larger scale.

## Setting the study context

### About the School

The school under study is a medium size preparatory school for boys located in the center of Doha city / Qatar. It is a semi-governmental school

**and belongs to a group of recently established independent schools under the indirect supervision of the SEC. Despite its novelty, the school has set out very ambitious goals. It is equipped with some of the most advanced scholastic facilities including smart boards, well-furnished science and computer laboratories, instructional softwares…etc.**

**The student body structure in the subject school is so diverse and so heterogeneous. Besides the native and non-native Qatari students, there are students from different nationalities including non-Qatari Arabic (Palestine, Egypt, Jordan, Syria, , Iraq, Yemen, Oman, Saudi Arabia, Kuwait, UAE, Tunisia, Algeria, Morocco, Mauritania, Somaliland and Sudan); and, non-Arabic nationalities (Iran, Pakistan, Britain, Bosnia, America, Canada and India) (Figure 1).**

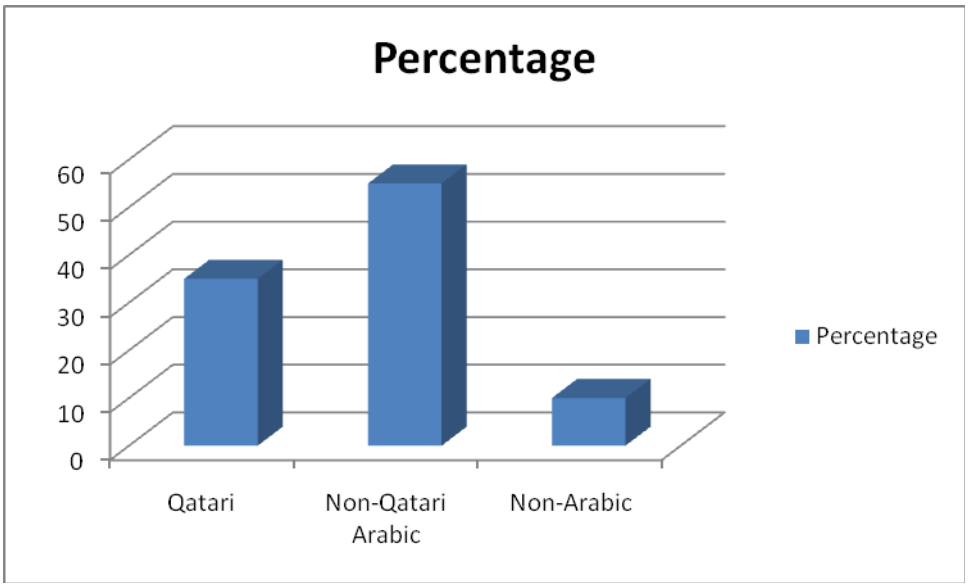


**Figure 1 The Percentages of the students nationalities at Hamza school.**

**Therefore, I best describe the school environment as being Multicultural where the classroom itself with its heterogeneity becomes a new learning experience. This multicultural environment is evident by the ethnicity, socio-economic background, home language (dialect), special needs, disability, and giftedness of the students. So, for Hamza School, the concept of diversity and heterogeneity was expanded to include not only the students' mixed ability but also their race, ethnicity, culture, home language, religion, social class, age, and disability.**

**Participants, Methods and Tools**

**The participants in the present study comprised a diverse group of 100 nine graders representing different nationalities including Qatari, non-Qatari Arabs and non-Arabs. The participants were equally distributed into four classes. A diagnostic pretest, a standardized posttest and survey**

**questionnaire methods were used in this study. A description of the employed method is given below.**

**Research Design and Procedure**

**The present study intends to determine the impact of homogeneous and heterogeneous collaborative learning groups on the achievement and attitude of nine graders towards science.**

**In order to determine the attitudes towards science, a questionnaire with 43 items (Cronbach's Alpha = 0.91) about science lessons was prepared and applied to 100 nine graders in Hamza school.**

**In Jan 2008, at the beginning of the 2nd semester of the academic year 2007/2008, a diagnostic test was administered to the students to rank them into low, intermediate and high achievers. The classification criteria were reinforced by the school's records about the achievement of the students in the previous years. Then, throughout the 2nd semester from Jan-June 2008, collaborative learning using homogeneous and heterogeneous groups was extensively implemented. To measure their achievement in science by the end of the academic year, the students had taken a standardized national test organized by the SEC in addition to the regular school test.**

**Before the start of the study we explained the rules of collaborative learning for the students that they must follow (Kenny et al., 1995):**

1- **Each group is responsible for working as a cooperative team.**
2- **Each team member is to give suggestions and help in completing the team assignments.**
3- **Each team member will seek help from other group members.**
4- **Each team member will help each other learn.**
5- **Each team will complete worksheets together.**
6- **Each team member will take the quiz. You will take the quiz by yourself, but you can help each other by helping others on your team learn.**
7- **If a team member has a question, he should ask the group before asking teachers. This is to make sure that everyone on the team has tried to solve a problem.**

**The above rules were made clear to the students and they agreed on following them. These rules were adopted from the research monograph[1] 95116. The CL strategy was applied using the Student Teams – Achievement Divisions (STAD) established by Slavin (1987). However, this**

[1] Research for this report was supported under the Javits Act Program (Grant No. R206R00001) as administered by the office of educational Research and improvement, U.S. Department of Education. Grantees undertaking such projects are encouraged to express freely their professional judgments. This, report, therefore, does not necessarily represent positions or policies of the Government, and no official endorsement should be inferred.

**strategy was modified where necessary to include a homogeneous group of students and to ensure that none of the group members is ignored.**

**The students' heterogeneity in this study was unpacked through two dimensions: the nationality of the students and their achievement or ability. In each of the 4 studied classes, 5 separate learning groups with 5 students in each were formed. Within the first three classrooms, three different types of groups were formed. The groups were either homogeneous (all high achievers or low to intermediate achievers), and heterogeneous mixed (two high achievers and three low to intermediate achievers). Students were not randomly assigned to either of the groups but considering a fair distribution of the available nationalities all over the groups unless the group is set to be entirely homogeneous (i.e. through both the nationality and ability dimensions). Each student was then given a personal identification code number.**

**Table 2 shows the composition and the distribution of the students among the studied classes. Three of the studied classes contained mixed ability students from different nationalities who formed entirely heterogeneous groups. Each group contained at least three different nationalities, one high achiever, two intermediate achievers and one low achiever (at risk student) unless stated otherwise. However, the fourth class contained only high achievement students from different nationalities. The groups formed in that class were heterogeneous only by the nationality dimension. Table 3 shows the numbers and the distribution of the students over the studied groups.**

| CLASS | GROUP | ABILITY | NATIONALITY |
|---|---|---|---|
| 1 | 1 | Heterogeneous | Heterogeneous |
| | 2 | Heterogeneous | Heterogeneous |
| | 3 | Heterogeneous | Heterogeneous |
| | 4 | Homogeneous *(low achievers)* | Homogeneous |
| | 5 | Homogeneous *(low achievers)* | Heterogeneous |
| 2 | 1 | Homogeneous *(low achievers)* | Homogeneous |
| | 2 | Homogeneous *(low achievers)* | Homogeneous |
| | 3 | Heterogeneous | Homogeneous |
| | 4 | Heterogeneous | Heterogeneous |
| | 5 | Heterogeneous | Homogeneous |
| 3 | 1 | Heterogeneous | Homogeneous |
| | 2 | Heterogeneous | Homogeneous |
| | 3 | Homogeneous *(low achievers)* | Heterogeneous |
| | 4 | Homogeneous *(high achievers)* | Homogeneous |
| | 5 | Homogeneous *(low achievers)* | Heterogeneous |
| 4 | 1 | Homogeneous *(high achievers)* | Heterogeneous |
| | 2 | Homogeneous *(high achievers)* | Heterogeneous |
| | 3 | Homogeneous *(high achievers)* | Heterogeneous |
| | 4 | Homogeneous *(high achievers)* | Homogeneous |
| | 5 | Homogeneous *(high achievers)* | Homogeneous |

**Table 2: Types of the formed learning groups in the four studied classes.**

| Type of the studied group | Number of participants |
|---|---|
| **Homogeneous by both / *[15 low ability + 15 high ability]*** | **30** |
| **Heterogeneous by both** | **20** |
| **Homogeneous by ability but heterogeneous by nationality / *[15 low ability + 15 high ability]*** | **30** |
| **Heterogeneous by ability but homogeneous by nationality** | **20** |
| **Total** | **100** |

**Table 3: Students numbers and distribution of the over the formed learning groups**

**Such distribution of students and groups allowed us to pool the students and to analyze them over the two studied dimensions.**

**In summary, the groups formed are:**

- **I- Heterogeneous:**
  - **a- By ability only**
  - **b- By nationality only**
  - **c- By both ability and nationality**
- **II- Homogeneous:**
  - **a- By ability only**
  - **b- By nationality only**
  - **c- By both ability and nationality**

**The data collection instruments in the present study were:**

- **A diagnostic test: to arrange the students in the corresponding homogeneous or heterogeneous groups according to their abilities.**
- **A questionnaire: to quantify the students' attitudes towards the subject under research as well as towards CL itself.**
- **Standardized posttest: to measure the students' achievement after the teaching techniques and strategies under study were implemented.**
- **General school's test: to ensure the reliability of the standardized tests by comparing the achievement of the students in both of them.**

**Moreover, the researchers used their observations and the school records about the kinds and the amounts of misbehavior to get a clearer idea about the student's personalities, their general attitudes and how they perceive themselves. Samples of students were interviewed at different phases of the research to ensure the adherence and coherence of the research to its objectives. Focus groups in which other teachers as well as students representatives participated, were formed to follow up the progress of the research.**

**Questionnaire**

**By the end of the academic year 2007/2008, a questionnaire was administered to a diverse group of 100 students representing different nationalities including Qatari, non-Qatari Arabs and non-Arabs. The questionnaire investigates the relationship between group composition and attitude towards science and group work. The students were asked to complete the questionnaire individually. All of the questionnaires were returned. However, only 89 could be used. The questionnaire was directed to measure the students' attitudes towards learning science and working in homogeneous and heterogeneous groups (See table 4).**

**The used questionnaire in the study was developed by reviewing the literature and consulting expert views in the area and pooled from different resources (White et al, 1997), (Fraser, 1982 cited by Osborne et al, 2003). Modifications were carried out where necessary to make the questionnaires more appropriate to the objectives of the current study. The reliability, internal consistency, of the questionnaire was calculated using a special online reliability calculator prepared by Del Siegle (www.gifted.uconn.edu /Siegle/research/Instrument%20Reliability%20and%20Validity/reliabilitycalcul) and found to be within the acceptable range (Cronbach's α = 0.91).**

**The questionnaire consisted of two parts (A & B); the first part comprised 22 items and was directed to measure the overall attitude towards learning science after CL has been applied, while the second part contained 21 items and was directed to measure the students' social and academic attitudes towards group work in science.**

**The items were rated on a 4-point Likert scale in an ascending order as follows:**

- **Strongly disagree - 1 point**
- **Disagree - 2 points**
- **Agree - 3 points**
- **Strongly agree - 4 points**

**The two parts of the questionnaire were designed to answer the question about the impact of heterogeneous groups by either the ability or nationality or both versus the homogeneous groups on the attitude of the nine graders towards learning science as well as the group work itself. Because of their negative nature, three of the questionnaire statements (14A, 15B & 19B) were reverse calculated by subtracting the given value from 4. Table 4 shows the different aspects and dimensions covered by the questionnaire that may formulate the learner's attitude towards science and group work:**

| Aspect / Dimension | Items No. |
|---|---|
| **Ability building / Self confidence / Academic Self-concept** | 3A, 15A, 16A, 19A, 21A, 6B, 7B, 8B, 20A, |
| **Statements:** ability to learn things quickly; plan and carry out school work; work on school problems by self; keep mind on what I am studying; I feel good about how well I am doing in Science; I am learning how to carry out science investigations; I am learning lots of useful skills such as measuring, recording results and plotting graphs; I can use my math skills in science to work out answers and draw graphs; I am learning about big ideas such as pollution, health problems, particles, forces and energy; Understanding scientific ideas is more important than memorizing facts; As a result of participating in group work, my ability to find, read and analyze information has improved; I feel that I can apply the general science principles I learned to "real world" situations; I am confident that I can analyze a science problem; I like being me; I like the way I act in school; I am happy with the way I can do things. | |
| **Enjoyment of science** | 1A, 2A, 4A, 6A, 7A, 9A |
| **Statements:** I enjoy Science at School; I look forward to science lesson; Science lessons are fun; I enjoy the activities we do in science; Science is one of the most interesting school subjects; I find science lessons interesting and enjoyable; time pass quickly at science lessons. | |
| **Independent development / Autonomy** | 5A, 10A, 15A, 17A, 22A , 8A |
| **Statements:** Decide things for self; make up own mind; choose solutions to problems; level of curiosity; working on something at home just to learn about it; work on science problems for fun; visit library to get information not required for class; I want to find out more about the world in which we live; finding out about new things is important; I use computers in science to help me to learn; application of science principles to other subjects is beneficial. | |
| **Instructor** | 11A, 17A |
| **Statements:** Science teachers help me to learn; science teachers help me use new scientific words and their meanings; science teacher expects everyone to do his best; science teacher often encourages everyone to speak out and takes part. | |
| **Sharing and peer relations** | 12A, 13A, 5B, 21B, |
| **Statements:** I get others understand me and my feelings easily; I face no problems in working with others to get something done; I make friendships with new students easily; class activities often facilitate knowing each other; I like talking to my friends about what we do in science, I am able to think and share my ideas in science; At the end of each project phase, the teacher expects us to share what we have learned and done; Sharing the results and artifacts created by me is very important to me. | |
| **Benefits obtained from CL** | 2B, 3B, 4B, 20B |
| **Statements:** Group work has a beneficial effect on learning science; Assigning a specific role to me in the group is useful and helps me to understand; Learning concepts through group work was beneficial; Compared to other courses at the school, group work helped me learn more than usual. | |
| **Enthusiasm towards CL** | 1B, 10B, 17B, 14A, |
| **Statements:** I think that learning about Science is important; We should have more | |

| | |
|---|---|
| science lessons each week; I feel comfortable working in groups; I feel satisfied after participating in a science group; Overall, I would rate the performance of my group very good. | |
| **Working with students from other countries** | 9B, 11B, 12B, 18B, 19B |
| **Statements:** I am confident that I can work with students from other countries; Working with students from other countries added to my experience and knowledge; It is always beneficial to have students from other countries in my class; I enjoy working in groups with students from different countries; I prefer working with students from my country. | |
| **Working in mixed ability (MA) groups** | 13B, 14B, 15B, 16B, 21B |
| **Statements:** Working in mixed groups, make it easier for us to complete a given task; Having high achiever in my group make it faster for us to solve the problem; When I work in low achievement group, it takes me longer to understand and solve the given problems; If given an opportunity, I would like to participate in groups with different ability students. | |

**Table 4: Dimensions, aspects and statements of the questionnaire.**

### Tests

**For the purpose of providing the decision makers with high-quality, objective information about the performance and the achievement of the students in the independent schools, the Evaluation Institute of the SEC holds annual Qatar Comprehensive Educational Assessment (QCEA) in the subject matters of Arabic, English, mathematics and science. The QCEA is based on the Qatar Curriculum Standards, which set a very high goal and compare with the best and most demanding educational standards worldwide. The QCEA is held nationwide where all independent schools with approximately 28,000 students participate in it. The performance of the students in the QCEA along with their results in the school's regular test was considered for comparative purposes to ensure the reliability of the results. The tests were administered to the students by the end of the academic year 2007/2008. However, a diagnostic pretest was initially administered to the students before the start of the study to rank and distribute the students into the corresponding learning groups.**

**The tests covered issues like health and genetic disorders, pollution, household electricity and chemistry of life. The items in the tests were different in their difficulties to match the hierarchal categories of the mental abilities in Bloom's taxonomy. The tests contained multiple choice questions as well as short essay questions. The QCEA was set by CTB/McGraw-Hill (CTB). The classroom based tests were developed by the researcher and reviewed by a panel of expert teachers in the school's science department.**

### Data Analysis

**The statistical analysis was carried out using (SPSS and Microsoft Excel). Descriptive statistics were used to analyze the data. The means and standard deviations, t-test and F-test, multivariate and univariate MANOVA**

**as well as post hoc tests were used to detect any statistically significant differences in the students' achievement and attitudes.**

## RESULTS

### I- The QCEA results:

**Evidence of discrepancy in the achievement of students and general academic underachievement in science was initially documented by analyzing the performance of the students in the Qatar Comprehensive Educational Assessments (QCEA).**

**The school report card prepared and published by the SEC (http://www. education.gov.qa/SRC/0708/files/ PREPIND 3370708LR.pdf) summarizes the performance of the students in the QCEA. According to the report, there was a significant increase in the means of the students' achievement in science. While for the academic year 2006/2007, it was 433; for the academic year 2007/2008, it became 483. Moreover, according to the report, the percentages of the students who enjoyed learning science in the school during the year 2006/2007 was 78%, while this percentage became 81% in the academic year 2007/2008.**

### II- School Achievement Tests:

#### a- The Pretest:

**The pretest (maximum mark = 50) was administered to the students at the beginning of the study to detect any statistically significant differences among the four different types of the learning groups. Table 5 summarizes the results of the pretest. The entirely homogeneous group scored highest and it had less standard deviation than in other groups. However, when the data were analyzed using ANOVA test (P=0.05), these differences were found to be not statistically significant (table 6). This gives a good indicator for an approximately equal achievement results and abilities of the students in the four groups that are due to the way the students were distributed over the four groups. This has made the four groups at nearly the same academic level at the beginning of the study a matter that enables the application of this research.**

| | *Heterogeneous Both* | *Homogeneous Both* | *Heterogeneous by Nationality / Homogeneous by Ability* | *Heterogeneous by Ability / Homogeneous by Nationality* |
|---|---|---|---|---|
| Mean | 8.13 | 9.42 | 7.70 | 7.14 |
| Median | 7.57 | 9.75 | 7.75 | 6.55 |
| Standard Deviation | 4.42 | 3.32 | 3.38 | 3.68 |
| Range | 16.30 | 12.30 | 13.10 | 13.10 |
| Minimum | 0.61 | 1.50 | 0.50 | 0.50 |
| Maximum | 16.90 | 13.80 | 13.60 | 13.60 |
| Sum | 162.59 | 282.63 | 231.10 | 142.70 |
| Count | 20 | 30 | 30 | 20 |

**Table 5: The performance of the students in the pretest.**

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 74.90 | 3 | 24.97 | 1.87 | 0.14 | 2.70 |
| Within Groups | 1280.11 | 96 | 13.33 | | | |
| Total | 1355.01 | 99 | | | | |

**Table 6: ANOVA table for the four studied groups.**

**b- The Posttest:**

**By the end of the academic year, the test was administered again to the students. The aim of the posttest was to answer the question about the effectiveness of CL and its impact on the achievement of the nine graders in science. The posttest specifically addressed the following questions:**

1. **Are there any statistically significant differences between the achievements of the students in the entirely heterogeneous group (i.e. by ability and nationality) in the pretest and the posttest?**
2. **Are there any statistically significant differences between the achievements of the students in the entirely homogeneous group in the pretest and the posttest?**
3. **Are there any statistically significant differences between the achievements of the students in the group heterogeneous by ability only in the pretest and the posttest?**
4. **Are there any statistically significant differences between the achievements of the students in the heterogeneous group by nationality only in the pretest and the posttest?**
5. **Are there any statistically significant differences between the achievements of the students due to the group type?**

**The study assumes that "there are statistically significant differences at (α=0.05) between the achievements of the students due to the group type". Table 7 summarizes the performance results of the students in the posttest.**

| | *Entirely Heterogeneous* | *Entirely Homogeneous* | *Heterogeneous by Nationality* | *Heterogeneous by Ability* |
|---|---|---|---|---|
| Mean | 34.88 | 40.80 | 40.84 | 39.08 |
| Standard Error | 1.35 | 1.25 | 0.88 | 1.08 |
| Median | 34.02 | 43.10 | 40.94 | 39.02 |
| Standard Deviation | 6.02 | 6.86 | 4.84 | 4.82 |
| Sample Variance | 36.28 | 47.07 | 23.40 | 23.21 |
| Range | 23.44 | 25 | 21.32 | 21.92 |
| Minimum | 24.12 | 25 | 27.82 | 27.93 |
| Maximum | 47.55 | 50 | 49.14 | 49.85 |
| Sum | 697.54 | 1223.99 | 1225.09 | 781.54 |
| Count | 20 | 30 | 30 | 20 |

**Table 7: The performance of the students in the posttest.**

**The results of the students in the posttest were analyzed using ANOVA (P=0.05) and it was revealed that there are statistically significant differences between the achievement of the students due to the group type (table 8). Therefore, the results were further analyzed using post hoc tests (α = 0.05) which allowed multiple comparisons between each of the pairs of groups (table 9).**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Observed Power |
|---|---|---|---|---|---|---|
| Corrected Model | 529.986[a] | 3 | 176.662 | 5.337 | .002 | .924 |
| Intercept | 145227.396 | 1 | 145227.396 | 4387.083 | .000 | 1.000 |
| Group | 529.986 | 3 | 176.662 | 5.337 | .002 | .924 |
| Error | 3177.927 | 96 | 33.103 | | | |
| Total | 157986.398 | 100 | | | | |
| Corrected Total | 3707.913 | 99 | | | | |

**Table 8: ANOVA table for the posttest results.**

| | (I) Group | (J) Group | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Tukey HSD | HeteroAbility | HeterogeneousBoth | 4.2015 | 1.81943 | .103 |
| | | HeteroNationality | -1.7502- | 1.66091 | .718 |
| | | Homogeneous Both | -1.7235- | 1.66091 | .728 |
| | HeterogeneousBoth | HeteroAbility | -4.2015- | 1.81943 | .103 |
| | | **HeteroNationality** | **-5.9517-** | **1.66091** | **.003** |
| | | **Homogeneous Both** | **-5.9250-** | **1.66091** | **.003** |
| | HeteroNationality | HeteroAbility | 1.7502 | 1.66091 | .718 |
| | | **HeterogeneousBoth** | **5.9517** | **1.66091** | **.003** |
| | | Homogeneous Both | .0267 | 1.48556 | 1.000 |
| | Homogeneous Both | HeteroAbility | 1.7235 | 1.66091 | .728 |
| | | **HeterogeneousBoth** | **5.9250*** | **1.66091** | **.003** |
| | | HeteroNationality | -.0267- | 1.48556 | 1.000 |
| Dunnett t (2-sided)[a] | HeterogeneousBoth | HeteroAbility | -4.2015- | 1.81943 | .058 |
| | HeteroNationality | HeteroAbility | 1.7502 | 1.66091 | .571 |
| | Homogeneous Both | HeteroAbility | 1.7235 | 1.66091 | .582 |

**Table 9: Multiple comparisons between the four studied groups.**

**Table 9 shows that the entirely heterogeneous group had statistically significant effect on the results of the students in the posttest when compared to the groups that are entirely or partially homogeneous (same ability but different nationality) regardless of the students' achievement level (high or low achievers). The students in the entirely heterogeneous group scored less than the students in the groups homogeneous by both the ability and nationality and also less than the students in the heterogeneous by nationality group.**

**Conclusion: As the heterogeneity of the group increases, the achievement decreases.**

**III- Questionnaire:**

**100 copies of the questionnaire (Cronbach's Alpha = 0.91) were distributed and the students were asked to complete it individually. However, only 89 were returned and considered valid for analysis. The responses of the students who participated in the homogeneous groups regardless of their achievement in the tests were pooled together because at this point we neglect the achievement factor and emphasize only on the attitudes towards science and group work.**

**For analyzing the questionnaire results using MANOVA, the group type was considered the independent variable while the students' responses were considered the dependent variables. However, the results of the questionnaire were analyzed in light of the following questions and hypothesis:**

- ***What are the main effects of the group type?***
- ***What are the interactions among the students' attitudes? (Any correlation between them)***
- ***What is the importance of the Students' attitudes?***
- ***What is the strength of association between the students' attitudes?***
- ***If the overall multivariate test is significant, we conclude that the respective effect (Group Type) is significant, then which attitudes have improved, one, or two…or all of them.***
- ***What specific attitude dimensions contributed to the significant overall effect?***

**Table 10 summarizes the results (means and standard deviations of each dimension in the attitude against the group type) of the students' responses in the questionnaire. Collaborative learning has enhanced the students' independent development and autonomy in the entirely heterogeneous groups (i.e. by both the nationality and ability) and it had least effect on the working with mixed ability students in the heterogeneous by nationality groups. A multivariate MANOVA at ($\alpha = 0.05$) was used to evaluate the effects of the four group types (heterogeneous versus homogeneous) on the students responses in the questionnaire.**

| Dimension | Group type | Mean | Std. Deviation | N |
|---|---|---|---|---|
| *Enjoyment of Science* | Heterogeneous Both | 3.5143 | .34384 | 23 |
| | Heterogeneous Nationality | 2.8568 | .73475 | 22 |
| | Heterogeneous Ability | 3.2465 | .51149 | 23 |
| | Homogeneous Both | 2.7857 | .56516 | 21 |
| | Total | 3.1107 | .62057 | 89 |
| *Independent Develop / Autonomy* | Heterogeneous Both | 3.6000 | .31334 | 23 |
| | Heterogeneous Nationality | 3.0364 | .41696 | 22 |
| | Heterogeneous Ability | 3.3826 | .42174 | 23 |
| | Homogeneous Both | 3.1143 | .40285 | 21 |
| | Total | 3.2899 | .44519 | 89 |
| *Instructor* | Heterogeneous Both | 3.5435 | .56232 | 23 |
| | Heterogeneous Nationality | 3.2500 | .71962 | 22 |
| | Heterogeneous Ability | 3.4348 | .43444 | 23 |
| | Homogeneous Both | 2.7857 | .69949 | 21 |
| | Total | 3.2640 | .66610 | 89 |
| *Sharing* | Heterogeneous Both | 3.2896 | .40654 | 23 |
| | Heterogeneous Nationality | 2.5918 | .67468 | 22 |
| | Heterogeneous Ability | 3.0443 | .44115 | 23 |
| | Homogeneous Both | 2.7138 | .66014 | 21 |
| | Total | 2.9179 | .61192 | 89 |
| *Benefits* | Heterogeneous Both | 3.3696 | .59767 | 23 |
| | Heterogeneous Nationality | 2.8750 | .78585 | 22 |
| | Heterogeneous Ability | 3.0435 | .52034 | 23 |
| | Homogeneous Both | 2.9048 | .68682 | 21 |
| | Total | 3.0534 | .67153 | 89 |
| *Enthusiasm* | Heterogeneous Both | 3.4935 | .44785 | 23 |
| | Heterogeneous Nationality | 2.9836 | .73025 | 22 |
| | Heterogeneous Ability | 3.4200 | .35196 | 23 |
| | Homogeneous Both | 2.9843 | .68692 | 21 |
| | Total | 3.2283 | .61055 | 89 |
| *Working with Mixed* | Heterogeneous Both | 3.2435 | .57511 | 23 |

| | | | | |
|---|---|---|---|---|
| | Heterogeneous Nationality | 2.4818 | .77989 | 22 |
| | Heterogeneous Ability | 2.9826 | .48585 | 23 |
| | Homogeneous Both | 3.0000 | .71274 | 21 |
| | Total | 2.9303 | .69289 | 89 |
| *Working with students from other countries* | Heterogeneous Both | 3.1739 | .39222 | 23 |
| | Heterogeneous Nationality | 3.0273 | .28483 | 22 |
| | Heterogeneous Ability | 3.0000 | .40899 | 23 |
| | Homogeneous Both | 3.1238 | .48775 | 21 |
| | Total | 3.0809 | .39854 | 89 |
| *Ability Building / Self confidence / Academic Self-concept* | Heterogeneous Both | 3.3878 | .22915 | 23 |
| | Heterogeneous Nationality | 2.6732 | .50145 | 22 |
| | Heterogeneous Ability | 3.1161 | .39670 | 23 |
| | Homogeneous Both | 2.7348 | .56936 | 21 |
| | Total | 2.9869 | .52183 | 89 |

**Table 10: Overall Summary results of the questionnaire dimensions against group type.**

**Table 11 shows the results of the Multivariate Analysis of the students' responses in the questionnaire. A statistically significant effect was found between the four groups (*Lambda (27, 225.522) = 2.51, P < 0.001*).**

| Effect | | Value | F | Hypothesis df | Error df | Sig. | Observed Power |
|---|---|---|---|---|---|---|---|
| Group | Pillai's Trace | .633 | 2.347 | 27.000 | 237.000 | .000 | .999 |
| | Wilks' Lambda | .464 | 2.514 | 27.000 | 225.522 | .000 | 1.000 |
| | Hotelling's Trace | .956 | 2.680 | 27.000 | 227.000 | .000 | 1.000 |
| | Roy's Largest Root | .697 | 6.115[c] | 9.000 | 79.000 | .000 | 1.000 |

**Table 11: Multivariate Analysis of the students' responses in the questionnaire.**

**Follow-up univariate MANOVA (table 12) indicated that the attitude components (Enjoyment of Science, Independent Development, Instructor, Sharing, Benefits from CL, Enthusiasm, Working with Mixed Ability Students and Ability Building) were significantly affected by the group type; while the group type had no effect on the students responses in the dimension (Working with students from other countries) (F (3, 85) = 0.946, p = 0.422).**

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Group | Ability Building | 7.581 | 3 | 2.527 | 13.112 | .000 |
| | Enjoyment of Science | 7.808 | 3 | 2.603 | 8.482 | .000 |
| | Ind Develop | 4.471 | 3 | 1.490 | 9.768 | .000 |
| | Instructor | 7.276 | 3 | 2.425 | 6.489 | .001 |
| | Sharing | 6.759 | 3 | 2.253 | 7.311 | .000 |
| | Benefits | 3.465 | 3 | 1.155 | 2.711 | .050 |
| | Enthusiasm | 5.030 | 3 | 1.677 | 5.131 | .003 |
| | Working with MA students | 6.846 | 3 | 2.282 | 5.479 | .002 |
| | Working with foreign students | .451 | 3 | .150 | .946 | .422 |
| Error | Ability Building | 16.381 | 85 | .193 | | |
| | Enjoyment of Science | 26.082 | 85 | .307 | | |
| | Ind Develop | 12.970 | 85 | .153 | | |
| | Instructor | 31.769 | 85 | .374 | | |
| | Sharing | 26.192 | 85 | .308 | | |
| | Benefits | 36.218 | 85 | .426 | | |
| | Enthusiasm | 27.774 | 85 | .327 | | |
| | Working with MA students | 35.402 | 85 | .416 | | |
| | Working with foreign students | 13.526 | 85 | .159 | | |

**Table 12: Univariate MANOVA test of between-subjects effects.**

**To determine which group types differ significantly for (Enjoyment of Science, Independent Development, Instructor, Sharing, Benefits from CL, Enthusiasm, Working with Mixed Ability Students, and Ability Building), pairwise comparisons and post hoc multivariate MANOVA and a paired t-test that compares the mean of each attitude dimension were performed (tables 13-21). The post hoc results using Tukey HSD reinforced the results of the pairewise comparisons. The Tukey post-hoc test was used because the homogeneity of variance assumption for the different attitude dimensions was not violated (p>0.05).**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Ability Building | Heterogeneous Both | Heterogeneous Nationality | .715* | .131 | .000 |
| | | Heterogeneous Ability | .272* | .129 | .039 |
| | | Homogeneous Both | .653* | .133 | .000 |
| | Heterogeneous Nationality | Heterogeneous Both | -.715-* | .131 | .000 |
| | | Heterogeneous Ability | -.443-* | .131 | .001 |
| | | Homogeneous Both | -.062- | .134 | .647 |
| | Heterogeneous Ability | Heterogeneous Both | -.272-* | .129 | .039 |
| | | Heterogeneous Nationality | .443* | .131 | .001 |
| | | Homogeneous Both | .381* | .133 | .005 |
| | Homogeneous Both | Heterogeneous Both | -.653-* | .133 | .000 |
| | | Heterogeneous Nationality | .062 | .134 | .647 |
| | | Heterogeneous Ability | -.381-* | .133 | .005 |

**Table 13: Pairwise Comparisons between the effects of the four group types on the "Ability Building and Self Confidence" dimension.**

**From table 13, it can be inferred that the students who participated in the group "heterogeneous by both the nationality and ability" showed significantly higher capability for "Ability Building / Self-Confidence / Academic Self-Concept" than the students in the corresponding groups. Also, the students in the group "heterogeneous by ability only" showed significantly higher response than the participants of the groups "heterogeneous by nationality only" and "homogeneous by both the nationality and ability".**

**Conclusion: Studying in entirely heterogeneous groups confers the students more capability for ability building, self-confidence and better academic self-concept. This effect is maximized when the group contains not only mixed ability students but also students from other nationalities.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Enjoyment of Science | Heterogeneous Both | Heterogeneous Nationality | .658* | .165 | .000 |
| | | Heterogeneous Ability | .268 | .163 | .105 |
| | | Homogeneous Both | .729* | .167 | .000 |
| | Heterogeneous Nationality | Heterogeneous Both | -.658-* | .165 | .000 |
| | | Heterogeneous Ability | -.390-* | .165 | .021 |
| | | Homogeneous Both | .071 | .169 | .675 |
| | Heterogeneous Ability | Heterogeneous Both | -.268- | .163 | .105 |
| | | Heterogeneous Nationality | .390* | .165 | .021 |
| | | Homogeneous Both | .461* | .167 | .007 |
| | Homogeneous Both | Heterogeneous Both | -.729-* | .167 | .000 |
| | | Heterogeneous Nationality | -.071- | .169 | .675 |
| | | Heterogeneous Ability | -.461-* | .167 | .007 |

**Table 14: Pairwise Comparisons between the effects of the four group types on the "Enjoyment of Science" dimension.**

**For the dimension "Enjoyment of Science" (table 14), there were statistically significant differences between the responses of the participants of the entirely heterogeneous group "i.e. by both the nationality and ability" when compared to the responses from the groups "heterogeneous by nationality only" and "homogeneous by both the nationality and ability". Also, there was a significant difference in favor for the students in the "heterogeneous by ability" when compared to the group "heterogeneous by nationality".**

**Conclusion: As the heterogeneous nature of the learning groups increases by either having more different nationalities, mixed ability students or both, the students enjoyment in learning science increases.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Ind Develop | Heterogeneous Both | Heterogeneous Nationality | .564* | .116 | .000 |
| | | Heterogeneous Ability | .217 | .115 | .063 |
| | | Homogeneous Both | .486* | .118 | .000 |
| | Heterogeneous Nationality | Heterogeneous Both | -.564-* | .116 | .000 |
| | | Heterogeneous Ability | -.346-* | .116 | .004 |
| | | Homogeneous Both | -.078- | .119 | .515 |
| | Heterogeneous Ability | Heterogeneous Both | -.217- | .115 | .063 |
| | | Heterogeneous Nationality | .346* | .116 | .004 |
| | | Homogeneous Both | .268* | .118 | .025 |
| | Homogeneous Both | Heterogeneous Both | -.486-* | .118 | .000 |
| | | Heterogeneous Nationality | .078 | .119 | .515 |
| | | Heterogeneous Ability | -.268-* | .118 | .025 |

**Table 13: Pairwise Comparisons between the effects of the four group types on the "Independent Development" dimension.**

**For the "Independent Development and Autonomy" dimension (table 15), there were statistically significant differences between the participants' responses in favor of the group "heterogeneous by both the nationality and ability" when compared to the groups "heterogeneous by nationality only" or "homogeneous by both the nationality and ability". Another significant difference was revealed when the students' responses in the group "heterogeneous by nationality" was compared to the responses from the group "heterogeneous by ability" and this difference was in favor for the participants in the latter group. One more significant difference was detected between the groups "heterogeneous by ability" and "entirely homogeneous" in favor for the homogeneous group.**

**Conclusion: Providing groups that are heterogeneous by ability and homogeneous by nationality increases the students' independent development and autonomy.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Instructor | Heterogeneous Both | Heterogeneous Nationality | .293 | .182 | .111 |
| | | Heterogeneous Ability | .109 | .180 | .548 |
| | | Homogeneous Both | .758* | .185 | .000 |
| | Heterogeneous Nationality | Heterogeneous Both | -.293- | .182 | .111 |
| | | Heterogeneous Ability | -.185- | .182 | .314 |
| | | Homogeneous Both | .464* | .187 | .015 |
| | Heterogeneous Ability | Heterogeneous Both | -.109- | .180 | .548 |
| | | Heterogeneous Nationality | .185 | .182 | .314 |
| | | Homogeneous Both | .649* | .185 | .001 |
| | Homogeneous Both | Heterogeneous Both | -.758-* | .185 | .000 |
| | | Heterogeneous Nationality | -.464-* | .187 | .015 |
| | | Heterogeneous Ability | -.649-* | .185 | .001 |

**Table16: Pairwise Comparisons between the effects of the four group types on the "Instructor" dimension.**

**According to table 16, the role of the instructor in formulating the students' attitudes was significantly affected by the group that is "homogeneous by both the nationality and ability". This effect was against the entirely homogeneous group and in favor of the other groups.**

**Conclusion: Group homogenization leads to more negative disposition towards the instructor dimension.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Sharing | Heterogeneous Both | Heterogeneous Nationality | .698* | .166 | .000 |
| | | Heterogeneous Ability | .245 | .164 | .138 |
| | | Homogeneous Both | .576* | .168 | .001 |
| | Heterogeneous Nationality | Heterogeneous Both | -.698-* | .166 | .000 |
| | | Heterogeneous Ability | -.453-* | .166 | .008 |
| | | Homogeneous Both | -.122- | .169 | .473 |
| | Heterogeneous Ability | Heterogeneous Both | -.245- | .164 | .138 |
| | | Heterogeneous Nationality | .453* | .166 | .008 |
| | | Homogeneous Both | .331 | .168 | .052 |
| | Homogeneous Both | Heterogeneous Both | -.576-* | .168 | .001 |
| | | Heterogeneous Nationality | .122 | .169 | .473 |
| | | Heterogeneous Ability | -.331- | .168 | .052 |

**Table17: Pairwise Comparisons between the effects of the four group types on the "Sharing and Peer Relations" dimension.**

**The "Sharing and Peer Relations" dimension (table 17) was affected by the group "heterogeneous by both the nationality and ability" when compared to the groups "heterogeneous by nationality" and "homogeneous by both the nationality and ability" in favor for the heterogeneous group. Another significant positive response was detected in the group "heterogeneous by ability only" when compared to the group "heterogeneous by nationality".**

**Conclusion: having mixed ability students in the learning groups improves the students sharing capabilities and the peer relations. This improvement can be enhanced if the group contains foreign students.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Benefits | Heterogeneous Both | Heterogeneous Nationality | .495* | .195 | .013 |
| | | Heterogeneous Ability | .326 | .192 | .094 |
| | | Homogeneous Both | .465* | .197 | .021 |
| | Heterogeneous Nationality | Heterogeneous Both | -.495-* | .195 | .013 |
| | | Heterogeneous Ability | -.168- | .195 | .389 |
| | | Homogeneous Both | -.030- | .199 | .882 |
| | Heterogeneous Ability | Heterogeneous Both | -.326- | .192 | .094 |
| | | Heterogeneous Nationality | .168 | .195 | .389 |
| | | Homogeneous Both | .139 | .197 | .483 |
| | Homogeneous Both | Heterogeneous Both | -.465-* | .197 | .021 |
| | | Heterogeneous Nationality | .030 | .199 | .882 |
| | | Heterogeneous Ability | -.139- | .197 | .483 |

**Table 18: Pairwise Comparisons between the effects of the four group types on the "Benefits from CL" dimension.**

**For the dimension "Benefits from CL" (table 18), the group "heterogeneous by both the ability and nationality" had significant effect compared to the groups "heterogeneous by nationality" and "homogeneous both". This effect was in favor of the heterogeneous group.**

**Conclusion: Studying in entirely heterogeneous groups, improves the students benefits from CL.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Enthusiasm | Heterogeneous Both | Heterogeneous Nationality | .510* | .170 | .004 |
| | | Heterogeneous Ability | .073 | .169 | .664 |
| | | Homogeneous Both | .509* | .173 | .004 |
| | Heterogeneous Nationality | Heterogeneous Both | -.510-* | .170 | .004 |
| | | Heterogeneous Ability | -.436-* | .170 | .012 |
| | | Homogeneous Both | .000 | .174 | .997 |
| | Heterogeneous Ability | Heterogeneous Both | -.073- | .169 | .664 |
| | | Heterogeneous Nationality | .436* | .170 | .012 |
| | | Homogeneous Both | .436* | .173 | .013 |
| | Homogeneous Both | Heterogeneous Both | -.509-* | .173 | .004 |
| | | Heterogeneous Nationality | .001 | .174 | .997 |
| | | Heterogeneous Ability | -.436-* | .173 | .013 |

**Table 1914: Pairwise Comparisons between the effects of the four group types on the "Enthusiasm" dimension.**

**For the "Enthusiasm" dimension (table 19), the group "heterogeneous by both the nationality and ability" had a significant effect when compared to the groups "heterogeneous by nationality" and "homogeneous by both the nationality and ability". Also, the group "heterogeneous by ability" had a significant effect compared to the group "heterogeneous by nationality".**

**Conclusion: Increasing the heterogeneity of a group by increasing the number of foreign or different culture students in a mixed ability class, improves the students' enthusiasm towards learning science.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Working with MA students | Heterogeneous Both | Heterogeneous Nationality | .762* | .192 | .000 |
| | | Heterogeneous Ability | .261 | .190 | .174 |
| | | Homogeneous Both | .243 | .195 | .215 |
| | Heterogeneous Nationality | Heterogeneous Both | -.762-* | .192 | .000 |
| | | Heterogeneous Ability | -.501-* | .192 | .011 |
| | | Homogeneous Both | -.518-* | .197 | .010 |
| | Heterogeneous Ability | Heterogeneous Both | -.261- | .190 | .174 |
| | | Heterogeneous Nationality | .501* | .192 | .011 |
| | | Homogeneous Both | -.017- | .195 | .929 |
| | Homogeneous Both | Heterogeneous Both | -.243- | .195 | .215 |
| | | Heterogeneous Nationality | .518* | .197 | .010 |
| | | Heterogeneous Ability | .017 | .195 | .929 |

**Table 20: Pairwise Comparisons between the effects of the four group types on the "Working with MA Students" dimension.**

**For the dimension "Working with Mixed Ability Students" (table 20), the students in the group "heterogeneous by both the nationality and ability" showed statistically significant difference when compared to the group "heterogeneous by nationality but homogeneous by ability". Also, the group "heterogeneous by ability" had a statistically better response when compared to the group "heterogeneous by nationality".**

**Conclusion: The students' attitudes towards working in mixed ability groups were affected by the group type. The students who studied in MA groups showed more positive response than the students who studied in homogeneous groups. This effect was enhanced when the MA groups contained students from different nationalities.**

| Dependent Variable | (I) Group type | (J) Group type | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| Working with foreign students | Heterogeneous Both | Heterogeneous Nationality | .147 | .119 | .221 |
| | | Heterogeneous Ability | .174 | .118 | .143 |
| | | Homogeneous Both | .050 | .120 | .678 |
| | Heterogeneous Nationality | Heterogeneous Both | -.147- | .119 | .221 |
| | | Heterogeneous Ability | .027 | .119 | .819 |
| | | Homogeneous Both | -.097- | .122 | .430 |
| | Heterogeneous Ability | Heterogeneous Both | -.174- | .118 | .143 |
| | | Heterogeneous Nationality | -.027- | .119 | .819 |
| | | Homogeneous Both | -.124- | .120 | .307 |
| | Homogeneous Both | Heterogeneous Both | -.050- | .120 | .678 |
| | | Heterogeneous Nationality | .097 | .122 | .430 |
| | | Heterogeneous Ability | .124 | .120 | .307 |

**Table 21: Pairwise Comparisons between the effects of the four group types on the "Working with Foreign Students" dimension.**

**For the dimension "Working with foreign students" (table 21), there were no statistically significant differences in the participants' responses due to the group type. Worth mentioning that, all groups scored relatively high in this dimension (table 10).**

**Conclusion: The group type whether entirely or partially heterogeneous had no effect on the students' attitudes towards working with students from different cultures.**

## DISCUSSION

**The current study aims at investigating the impact of homogeneous versus heterogeneous collaborative learning grouping in multicultural classes on the students' achievement and attitude towards learning science. In the present study, heterogeneity was unpacked through two dimensions: the culture, represented by the different nationalities present and the students' mixed abilities.**

**According to the results of this research, the main effects of group structure on the students' attitudes towards learning science were demonstrated by the heterogeneous group. It affects all the attitude dimensions except the "working with different culture students" where nearly all group types affect it at the same level. This result supports the findings of other researches. However, this positive attitude was enhanced when the effect of MA classes was combined with the effect of multicultural classes. Having foreign students or students from different cultures in a mixed ability class, yields the best desired results. Therefore, the researcher highly recommends maximizing the heterogeneity in a class in all possible dimensions. The positive dialogue and talks, negotiations, exchange of experiences, made learning more fun and beneficial for the students, enhanced their self confidence, academic awareness, and overall their positive attitude towards science.**

**This was also demonstrated by the comments that the students made in individual interviews when they were asked open questions to express their opinions about the group they are learning in.**

**In this study, the "instructor and his role" dimension actually represents and accounts for the instructional techniques used in implementing CL in the lesson. The method of applying the CL is considered a crucial factor for its success. A point for consideration in forming heterogeneous groups of students from different cultural backgrounds is the fear of getting some members of the group isolated by any chance. The instructor was fully aware of this point.**

**Worth noting that, there were no significant differences among the responses of the participants of the four groups towards working with students from other countries or cultures where all students regardless of the group nature scored relatively high. This might be explained by the welcoming nature of the Qatari-Arabic culture, its openness and tolerance tendency that served in this research as a medium in which other cultures interacted among themselves and with it.**

**Analyzing the achievement results in the posttest revealed the heterogeneity factor had a negative effect on the achievement of the students. The students in the mixed ability classes scored less than the students in other groups. When the groups were entirely heterogeneous (i.e. by both the ability and nationality dimensions), the results were the least. However, when the homogeneous groups by ability (no matter high or low achievers) contained different nationality students, the results were the most favorable. Therefore, when considering the achievement, the heterogeneity factor should be approached with extreme awareness. Moreover, the students placed appropriately in regular classes do not suffer socially or emotionally when students identified as academically**

**talented or gifted are served in separate, homogeneous classes (Sheilds, 2002).**

**In summary, for seeking the optimum class composition that may yield best achievement results and constructs positive attitudes; a compromise that maximizes group diversity and prevents individual isolation should be adopted…let the same ability students with different cultural backgrounds work cooperatively together. It is the interaction between the two factors (ability + multiculturalism) seems to give the best desired results.**

**In multicultural classes, cooperative learning alone cannot provide quality teaching and consequently the desired results. The way it is implemented and the overall school context determine its usefulness and effectiveness. Collaborative learning should be supported by a multicultural education program, otherwise it would have little if any positive effect on the students achievement and attitudes towards learning science.**

**The multicultural education as a means to provide a quality teaching for a diverse group of students, was taken along with some other issues including topics like behavior, health and safety, special educational needs, child protection and environmental education as a whole-school issue that should involve the entire school community including teachers, support staff, principal and directors, pupils, parents and the wider community. There is no single member of the school community who is solely responsible for the above issue. Providing quality teaching can only be tackled in an integrated and inclusive manner. Therefore, a "Whole School Approach" (WSA) was developed to tackle this problem. The results of the present study wouldn't be achieved if the school hadn't adopted and implemented different strategies and techniques to reduce any negative effects of the heterogeneous structure.**

**Learning as a behavioral process is very complex and multifactorial. The interactions between the multiple factors governing learning in the WSA will remain to a certain extent ambiguous. Where one factor may have a positive effect, another one may have another effect; however, the cumulative effect of all these factors was tested. Because when these factors are joined together in one group they might act differently (in a different way from that if they were assayed singly) due to their interactions.**

**The Whole School Approach implemented by the school served as the context in which the current study was applied. It aims at providing a safe and friendly multicultural environment and initiating a multicultural education program. The "Whole School Approach" as a strategy positively utilizes the heterogeneity of the students' body structure. It comprises daily practices, teaching strategies, curricular and extracurricular activities, school regulations and rules affecting the student from the moment he**

**joins the school until his graduation. As reflected in its mission statement, Hamza school requires that students respect and appreciate each other, work collaboratively together, and that teachers should provide the students with motivating learning experiences that have personal, cultural, and community relevance, and experience success. This approach adopted and followed by all school members to support the students learning.**

**Finally, this research is a call for the school administrations and principals to adapt the school policies to create a positive multicultural environment and to initiate their multicultural education programs.**

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