

EFFECTS OF HETEROGENEOUS AND HOMOGENEOUS GROUPING
ON STUDENT LEARNING

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ABSTRACT

Zhongwan Wang: Effects of Heterogeneous and Homogeneous Grouping on Student Learning
(Under the direction of Rune J. Simeonsson, Ph.D.)

This thesis focuses on the effects of different grouping strategies (homogenous and heterogeneous) on learning of college-level students in cooperative learning contexts. The main findings are: (1) heterogeneous grouping based on student ability is more beneficial for student achievement and student satisfaction; high and medium level ability students benefit more in homogeneous groups but low level ability students benefit more in heterogeneous groups; (2) no consistent conclusion could be drawn about effects of grouping from studies in which groups were based on race and culture; (3) heterogeneous grouping based on learning styles is more beneficial for student satisfaction with their learning and their attitudes toward other students rather than student achievement; and (4) studies in which groups were based on personal characteristics support heterogeneous grouping, but the results of experiments differed. Overall, heterogeneous grouping is more beneficial for student achievement as well as student satisfaction than homogeneous grouping.

TABLE OF CONTENTS

LIST OF TABLES.....	v
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: LITERATURE REVIEW.....	4
Cooperative Learning.....	4
Theoretical foundations of cooperative learning.....	6
Heterogeneous grouping and homogeneous grouping in cooperative learning.....	8
Theoretical foundations of grouping.....	9
CHAPTER 3: METHOD.....	12
CHAPTER 4: RESULTS.....	17
Studies of grouping based on abilities.....	18
Studies of grouping based on race and culture.....	28
Studies of grouping based on learning styles.....	31
Studies of grouping based on personal characteristics.....	39
CHAPTER 5: DISCUSSION.....	44
Limitations.....	46
Conclusion.....	47
REFERENCES.....	48

LIST OF TABLES

Table

1. Summary of empirical studies.....	14
2. Studies in which groups were formed on the basis of student abilities.....	24
3. Summary of studies in which groups were formed on the basis of student abilities.....	25
4. Relations between different ability levels and groupings.....	27
5. Studies in which groups were formed on the basis of race and culture.....	30
6. Studies in which groups were formed on the basis of learning styles.....	37
7. Summary of studies in which groups were formed on the basis of learning styles.....	38
8. Studies in which groups were formed on the basis of personal characteristics.....	41
9. Summary of effects on student achievement and satisfaction based on different grouping strategies.....	42

CHAPTER 1: INTRODUCTION

How can a person be successful in the society full of fierce competition? People may have different answers for this question. However, academic achievement and social relationships play important roles during the process of success (Slavin, 1981). Colleges want students to succeed in society, thus they provide education for students to gain knowledge as well as social skills. With this aim, more and more colleges are changing their teaching methods from traditional or competitive learning to cooperative learning (Slavin, 1981).

According to Slavin (2010), cooperative learning is defined as “instructional methods in which teachers organize students into small groups, then work together to help one another learn academic content” (p.344). Although each student in the same group has his or her own task which is part of the whole group task, they are evaluated on the basis of the whole group performance (Slavin, 1980; 1995). Research has indicated that students in a cooperative learning environment perform better than those in a traditional learning environment (Slavin, 1980, 1981).

Some theoretical perspectives provide support for this finding. Social interactions play very important roles when students study (Webb, 1982). During the process of learning, the acquisition of knowledge is easier if a student’s information or ideas can be actively shared with other students (Jonassen & Kwon, 2001; Tutty & Klein, 2008). In a cooperative learning environment, no matter presenting or listening to information, students are influenced by the new or conflicting information affecting their previous knowledge (Miller, 1993). They express their own thoughts to other students when they are in discussions in cooperative learning. The

differences among thoughts lead them to re-think, and then they may change or revise their original ideas (Miller, 1993). In cooperative learning, effects of cooperative interactions on student learning rely on the level of group members' participation (Slavin, 1983). If they are willing to actively share information with other members, and accept feedback positively, the effects of cooperative interactions on student learning are positive (Slavin, 1983). If they are not willing to express themselves, but only receive feedback passively, the effects are negative (Noddings, 1985). However, one question is: How can students be grouped appropriately so that cooperative interactions can have positive influence on students learning? Generally speaking, two grouping strategies are commonly used: heterogeneous grouping and homogeneous grouping.

In heterogeneous groups, students in one group differ on the basis of race, gender, learning ability, previous academic performance, or other relevant characteristics (Oetzel, 1998; Slavin, 1995). In homogeneous groups, students in one group have similar learning abilities, previous academic performance, or other cognitive characteristics. The research has focused on the effects on academic achievement and satisfaction of students when they are in heterogeneous or homogeneous groups based on race and culture, learning abilities and learning styles (Oetzel, 1998; Slavin, 1981).

Researchers express different views about the effects of heterogeneous and homogeneous ability-grouping on student learning. Some researchers believe heterogeneous grouping benefits student learning more than homogeneous grouping. For example, Slavin (1993) indicates that heterogeneous grouping based on abilities benefits student learning. Tutty and Klein (2008) state that lower ability students benefit more from heterogeneous grouping because they can get assistance from other members. During discussions, students could better understand questions and successfully finish tasks. However, other researchers support homogeneous grouping. For

example, Baer (2003) has shown that students in homogeneous groups perform better than those in heterogeneous groups. Homogenous grouping can positively influence high and average ability students while it does not affect low ability students (Baer, 2003).

Heterogeneous grouping is used in most research which focuses on effectiveness of cooperative learning (e.g., Slavin, 1984; Skidmore & Aagaard, 2004). This phenomenon easily leads people to believe heterogeneous grouping is the best grouping when cooperative learning is used (Watson & Marshall, 1995). However, some research indicates that heterogeneous grouping is not more effective than homogeneous grouping when cooperative learning is used (e.g., Baer, 2003; Miller & Polito, 1999). In other words, when cooperative learning is used, which grouping (heterogeneous or homogeneous grouping) is better for student achievement, their satisfaction and their attitude towards other students in one group is still an open question. The goal of this review is to provide an overview of the research on the effectiveness of heterogeneous and homogeneous grouping on the learning of college students, which includes two aspects: student achievement and student satisfaction when cooperative learning is used in the classroom. Therefore, I addressed the following research question: What are the effects of different grouping strategies (homogenous and heterogeneous) on learning of college-level students in cooperative learning contexts?

CHAPTER 2: LITERATURE REVIEW

In this section, I introduce the definition of cooperative learning and its main elements, and then compare the effects of cooperative learning, individual learning and competitive learning. After that, four theoretical perspectives of cooperative learning are described. In addition, I review research which focuses on heterogeneous and homogeneous grouping under cooperative learning. The advantages and disadvantages of heterogeneous and homogeneous grouping are summarized, and the theoretical foundations of grouping are introduced.

Cooperative learning

According to Slavin (2010), cooperative learning is defined as “instructional methods in which teachers organize students into small groups, which then work together to help one another learn academic content” (p.344). Research has shown that cooperative learning is very useful to improve student learning as well as social skills because through discussions in cooperative learning, students not only strengthen the understanding of their own thoughts, but also have more opportunities to communicate with others (Miller & Polito, 1999; Slavin, 1980, 1995). According to Watson and Marshall (1995), task structures, cooperative incentive structures, individual accountability, and heterogeneous grouping are the four elements of cooperative learning.

Task structure is the activities used in classrooms such as lectures, pair work and discussions (Slavin, 1980). Task specialization and group study are two different kinds of task structures (Slavin, 1983, 1995; Watson & Marshall, 1995). Each member in task specialization is

required to do one part of the task, and then the group combines them (Watson & Marshall, 1995). All group members in group study work together on the same task, they solve each small part of the task together, but they do not need to finish each part of the task individually (Slavin, 1995; Watson & Marshall, 1995).

There are three different reward structures during the general learning process (Slavin & Tanner, 1979; Watson & Marshall, 1995). A cooperative reward structure in cooperative learning means rewards for an individual are based on the good performance of other individuals in the same team (Slavin & Tanner, 1979). In other words, the success of one individual requires the success of all individuals in the same group. A competitive reward structure means that the failure of one person leads to the success of another individual (Slavin & Tanner, 1979). An individual reward structure means that rewards for an individual totally depend on his or her own performance, and have nothing to do with the performance of other individuals (Slavin & Tanner, 1979). Different reward structures have been proved to increase individual performance in different learning environments (Michaels, 1977; Miller & Hamblin, 1963; Slavin, 1977; Slavin & Tanner, 1979). Without cooperative rewards, cooperative learning may not help students enhance academic achievement (Slavin & Tanner, 1979; Slavin, 1991).

Individual accountability means that good individual performance of all members in the group, rather than the group outcome as a whole, is the basis of group rewards (Slavin, 1995, 2010). Each member in cooperative learning has to help others to understand new knowledge well, and ensure everyone in the group truly learns the knowledge, so that when students are individually tested, they can independently give right answers (Slavin, 1983, 1995, 2010).

Heterogeneous grouping is another element of cooperative learning (Watson & Marshall, 1995). Students in heterogeneous groups are different from other members on a certain factor which is the base of forming groups. A section is created after explaining the theoretical basis of cooperative learning to introduce two main group strategies which are heterogeneous grouping and homogeneous grouping.

Cooperative learning has been proven to improve the attitude of students towards learning as well as towards their classmates (Camara et al., 2007). When students discuss the information with other members, they can learn better because discussions benefit their understanding of knowledge (Jonassen & Kwon, 2001; Tutty & Klein, 2008). The interactions among group members develop their social skills (Miller, 1993). According to Slavin (1980), compared with students who use individual learning approaches or competitive approaches, students using cooperative learning approaches learn better and communicate better.

Theoretical foundations of cooperative learning

Many theorists try to use theories to explain the relations between cooperative learning and student learning, especially under what kinds of conditions cooperative learning can positively affect student learning (Slavin, 2010). According to Slavin (2010), “motivational, social cohesion, cognitive-developmental and cognitive-elaboration theoretical perspectives are the four major perspectives on the achievement effects of cooperative learning” (p. 345).

According to Slavin (1995, 2010), the *motivational perspective* states that cooperative learning encourages learners to not only work on their own but also help and inspire other group members to learn because the success of the group is equivalent to success of each group member. The motivational theorists hold the opinion that individual and competitive rewards in

traditional classrooms reduce the acceptance of high achievers; therefore cooperative rewards should be emphasized and applied (Slavin, 1995, 2010). When cooperative rewards are applied, group members are rewarded on the basis of their group performance rather than their separate individual performance, thus the only way for them to get both awards and acceptance is to try their best to help other members, including answering questions and offering appropriate feedback (Slavin, 1995, 2010).

The *social cohesion perspective* holds that members in a group will study hard and support other group members to achieve more (Slavin, 2010). The difference between the social cohesion perspective and the motivational perspective is the explanation of the reason why group members work for others: the motivational theorists believe that the reason for members helping others is mainly for their own interests while the social cohesion theorists believe that the reason for members helping others is mainly for other members' interests as a result of emotional connections among the members (Slavin, 2010).

The cognitive perspective does not focus on the purpose and motivation of the learners in the group — the cognitive theorists believe that the cooperative activities will increase the achievement of the learners no matter whether they tend to study hard or not (Slavin, 2010). Two main sub-perspectives under cognitive perspective are the cognitive elaboration perspective and the cognitive developmental perspective, both of which explain the reason why cooperative learning activities have better effects (Slavin, 1995, 2010).

The *cognitive elaboration* perspective states that the learning procedure in cooperative learning has a particular part — expressing what students have learned to other students. This procedure recalls students' previous knowledge and forces them to organize the information they

have, which benefits their comprehension of the knowledge and increases their achievement (Slavin, 2010). In cooperative learning, when students express their own thoughts, discuss or even argue about thoughts of other students, the interactions among group members lead them to reorganize information based on their own comprehension, and then share it to other members (Larson et al., 1984; Slavin, 2010). Such activities expand the knowledge base, help them to better understand their own thoughts, adjust their thoughts according to the discussions (Slavin, 1995, 2010).

The cognitive developmental perspective holds a slightly different opinion, which is that cooperative activities naturally accelerate the development of learning, and some knowledge can be only absorbed from cooperative activities (Slavin, 2010). Therefore, cooperative learning instinctively increases the achievement of learners. Vygotsky (1978) defined the zone of proximal development as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers” (p86). Vygotsky believed that interactions with more skillful peers can assist less knowledgeable students to develop skills and achieve tasks (Miller, 1993). However, the assistance should be based on a student’s actual and potential levels of development, not too high or too low from the actual level of development of the less knowledgeable student (Miller, 1993; Vygotsky, 1978)

Heterogeneous grouping and homogeneous grouping in cooperative learning

According to Slavin (1990), the communications among group members in heterogeneous groups lead them to understand their own thoughts as well as thoughts of other members which can help them to successfully finish group tasks. However, the learning

atmosphere of heterogeneous groups may not be as good as that of homogeneous groups because in heterogeneous groups, conflict can be more serious due to different perspectives and backgrounds (Schullery & Schullery, 2006).

In most research related with cooperative learning, heterogeneous grouping is used to form groups (Watson & Marshall, 1995). However, it does not mean heterogeneous grouping is a better strategy to form groups than homogeneous grouping considering the limited amount of empirical research supporting the effects of heterogeneous grouping on student learning (Watson & Marshall, 1995). In fact, both heterogeneous and homogeneous grouping has been supported as group composition in cooperative learning research. Some studies (e.g., Lawrenz & Munch, 1984; Watson & Marshall, 1995) have shown that students in homogeneous groups have better performance than students in heterogeneous groups, while other studies (e.g., O'Donnell & Dansereau, 1992) have found that low-ability students in heterogeneous groups have better performance than in homogeneous groups. Thus, the question remains: which grouping is better when cooperative learning is used with college-level students, heterogeneous grouping or homogeneous grouping?

Theoretical foundations of grouping

According to Miller and Polito (1999) and Watson and Marshall (1995), the group achievement may be affected by different factors including student ability, gender and personality. The concepts of interdependence and social identity which describe the factors influencing effects of grouping on student learning are introduced. These theories are used in chapter four and five to explain the results of studies reviewed.

According to Wageman (1995), interdependence means that group members can positively or negatively affect one another by behaviors, attitudes and experiences. In cooperative learning, group members have to complete his or her part of the whole task in order to achieve group goals (Wageman, 1995). The interactions such as the helping and discussions depend on high level of interdependence (Wageman and Baker, 1997).

Personal identity and social identity play important roles in cooperative learning. Individuals in a group want to be part of the group due to social identity, so they try to find commons between other members and themselves (Brewer, 1991; Miller & Polito, 1999). Meanwhile, they also want to be themselves due to personal identity, so they try to be different from other members (Brewer, 1991). These two identities cause conflicts as well as cooperation among group members in cooperative learning (Brewer, 1991). However, the conflicts can increase group creativity and help members to have better performance (Troyer and Youngreen, 2009).

Cooperative learning is supported by the four theoretical perspectives including motivational, social cohesion, cognitive-developmental and cognitive-elaboration theoretical perspectives (Slavin, 1995; 2010). One important element of cooperative learning is grouping. The interactions among group members lead them to sharing information and expressing their own thoughts. The zone of proximal development suggests that less knowledgeable students can obtain assistance from more knowledgeable peers through interactions to develop skills (Miller, 1993; Vygotsky, 1978). Group members are influenced by each other. The personal identity and social identity lead members to be similar with others as well as different from others, thus cause conflicts and cooperation which may contribute to group creativity. The effectiveness of two

main types of grouping, heterogeneous and homogeneous grouping, are addressed in this review to examine that which type of grouping is beneficial more for college student learning.

CHAPTER 3: METHOD

The purpose of this study is to review effects of heterogeneous and homogeneous groupings on learning of students when cooperative learning is used at the college level, and to clarify the role of grouping in cooperative learning contexts. This review addresses the research question: what are the effects of different grouping strategies (homogenous and heterogeneous) on the learning of college-level students in cooperative learning contexts?

In order to conduct my review, narrative synthesis is used. This thesis focuses on the effects of heterogeneous and homogeneous grouping on student learning when cooperative learning is used at colleges. The results of empirical studies I have found are diverse due to the diversity of participants, grouping factors and outcome variables in those studies. In order to find the differences among those studies and draw conclusions, comparing and contrasting the results are necessary steps of this review. Narrative synthesis is reliable because by using this method, differences can be easily found when the processes and results of experiments are compared and contrasted (Popay, et al., 2006).

The article “Guidance on the conduct of narrative synthesis in systematic reviews: a product from the ESRC methods program” (Popay, et al., 2006) describes how to properly conduct a narrative synthesis. After identifying empirical studies that related to my topic, I used the following steps of narrative synthesis according to the above article (Popay, et al., 2006):

Step 1: Identified all the relevant empirical studies

Identified all the empirical studies related to my topic, understood their research questions, participations, methods, and results, and developed a table.

Step 2: Found relationships between those studies and grouped them

Explored relationships between the studies based on step 1.

Step 3: Compared and contrasted results of studies

Step 4: Summarized similarities and differences within and between groups

Step 5: Drew conclusions related to theories.

Empirical studies written in English and published among 1980 to 2012 are searched. Representative journals including *College Teaching*, *Educational Technology Research and Development*, *Journal of Advanced Nursing*, *Journal of Educational Psychology*, *Learning and Instruction* and *Journal of Management Education* were reviewed to find studies that compared the effects of heterogeneous grouping and homogeneous grouping when cooperative learning was used with undergraduate students. This was followed up with a search through the last 12 years of relevant journals, including *Review of Educational Research*, *Educational Psychologist*, and *Educational Psychology Review*, which identified reviews on the effects of ability grouping in elementary schools (e.g., Slavin, 1987), or small-group learning on undergraduates in science (e.g., Springer, Stanne, & Donovan, 1999); however, there was no review comparing the effects of heterogeneous grouping and homogeneous grouping when cooperative learning was used with undergraduate students. Thus, for this research, I reviewed empirical studies that focused on the effects of comparing heterogeneous grouping and homogeneous grouping on undergraduate students' achievement and attitudes when cooperative learning was used.

To locate empirical studies that bear on this research question, The following databases were searched: Educational Resources Information Centre (ERIC), Academic Search Complete; PsycINFO, Education Full Text, Social Work Abstracts, and MasterFILE Complete with key words: Heterogeneous AND homogeneous AND cooperative learning AND group* AND college OR university OR “higher education”. Key words search was also expanded: (Heterogeneous AND homogeneous) OR (ability grouping) AND cooperative learning AND college OR university OR “higher education”.

From the results list, only studies which were written in English as well as published in peer reviewed journals between 1980 and 2012 were included if the key words above were in the articles. I also searched the references of the articles identified in the first stage to check if any other articles can be found. Finally, the Social Science Citation Index was also used to search relevant empirical studies. Nineteen empirical studies I found in the review are listed at Table 1.

Table 1

Summary of empirical studies

Author	Year	Title	Journal
Ross	1980	Matching Achievement Styles and Instructional Environments	<i>Contemporary Educational Psychology</i> , 5(3), 216-226.
Larson et al.	1984	Verbal ability and cooperative learning: transfer of effects	<i>Journal of Literacy Research</i> , 16(4), 289-295.
Watson & Marshall	1995	Effects of cooperative incentives and heterogeneous arrangement on achievement and Interaction of cooperative learning groups in a college life science course	<i>Journal of Research in Science Teaching</i> , 32(3), 291-299.
Usluata	1997	From conflict to harmony: a heterogeneous group in a business communication class in Turkey	<i>Business Communication Quarterly</i> , 60(1), 124-133.

Oetzel	1998	Culturally homogeneous and heterogeneous groups: explaining communication processes through individualism-collectivism and self-construal	<i>International Journal of intercultural relations</i> , 22(2), 135-161.
Cobb	1999	Interactive videodisc instruction with undergraduate nursing students using cooperative learning strategies	<i>Computers in Nursing</i> , 17(2), 89-96.
Miller & Polito	1999	The effect of cooperative learning team compositions on selected learner outcomes	<i>Journal of Agricultural Education</i> , 40(1), 66-81.
Baer	2003	Grouping and achievement in cooperative learning	<i>College Teaching</i> , 51(4), 169-175.
Koppenhaver & Shrader	2003	Structuring the Classroom for Performance: Cooperative Learning with Instructor-Assigned Teams	<i>Decision Sciences Journal of Innovative Education</i> , 1(1), 1-21.
Shen	2003	A comparison of written Chinese achievement among heritage learners in homogeneous and heterogeneous groups	<i>Foreign Language Annals</i> , 36(2), 258-266.
Kinchin & Hay	2005	Using concept maps to optimize the composition of collaborative student groups: a pilot study	<i>Journal of Advanced Nursing</i> , 51(2), 182-187.
Maloolf & White	2005	Team study training in the college biology laboratory	<i>Journal of Biological Education</i> , 39(3), 120-124.
Schullery & Schullery	2006	Are heterogeneous or homogeneous groups more beneficial to students?	<i>Journal of Management Education</i> , 30(4), 542-556.
Camara et al.	2007	One approach to formulating and evaluating student work groups in legal environment of business courses	<i>Journal of Legal Studies Education</i> , 24(1), 1-18.
Stapleton	2007	Effects of team composition on problem solving: an empirical investigation of the assembly effect	<i>Delta Pi Epsilon Journal</i> , 49(2), 94-108.
Tutty & Klein	2008	Computer-mediated instruction: a comparison of online and face-to-face collaboration	<i>Educational Technology Research and Development</i> , 56(2), 101-124.
Jensen & Lawson	2011	Effects of Collaborative Group Composition and Inquiry Instruction on Reasoning Gains and Achievement in Undergraduate Biology	<i>CBE-Life Sciences Education</i> , 10(1), 64-73.
Miller et al.	2012	Student learning outcomes and attitudes when Biotechnology lab partners are of different academic levels	<i>CBE-Life Sciences Education</i> , 11(3), 323-332.

Kyprianidou et al.	2012	Group formation based on learning styles: can it improve students' teamwork?	<i>Educational Technology Research and Development, 60(1), 83-110.</i>
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CHAPTER 4: RESULTS

In this section, results addressed the research question: What are the effects of different grouping strategies (homogenous and heterogeneous) on learning for college-level students in cooperative learning contexts?

Many experimental studies have been conducted to exam the effects of different grouping strategies on learning for college-level students in cooperative learning contexts. Because different group strategies affect the impact of cooperative learning through different factors (Watson & Marshall, 1995), this review is organized on the basis of the different factors that formed different groups in those studies which are abilities, race and culture, learning styles, and personal characteristics. Student satisfaction with learning or with group members and student achievement are the two aspects of the effectiveness of grouping strategies on student learning (Larson et al, 1984; Miller et al., 2012; Skidmore & Aagaard, 2004), therefore, this review focuses on these two aspects as the metrics of the effectiveness of grouping strategies. As a result, the studies in this review are divided into four categories based on the four factors above. In each category, groups were based on the same factor; and similar methods and process were used with the purpose of comparing the effects of homogenous grouping and heterogeneous grouping on satisfaction and achievement of college-level students in cooperative learning contexts. Besides, broader analysis across studies is done at the end of each category.

Studies of grouping based on abilities

Larson et al., (1984) conducted a three-session experiment to examine the effects of heterogeneous and homogeneous pairs on student learning. The result indicated that the ability of the partner affected the work of the other individual. More importantly, the performance of students with heterogeneous ability partners was better than those with homogeneous partners. In this experiment, all participants were divided by high or low verbal ability based on a test. Four types of groups were formed after each student was randomly assigned a partner: high-high ability groups, low-low ability groups, high-low ability groups and low-high ability groups. A passage about plate tectonics with five segments was required to be learned cooperatively by all pairs who were told to help their partners to learn the materials. Both students in each pair first read each segment silently, and then one was a recaller and the other was a listener. The recaller orally presented his or her understanding about the segment then the listener corrected or elaborated it to improve their understanding. The two members of the group switched their roles of recaller and listener when they learned the next segment. After finishing learning this passage, all students individually studied a passage about ecosystems, and then took two independent tests. The results showed that individuals with heterogeneous partners recalled more ideas than those with homogeneous partners. This result is supported by the motivational perspective. In this experiment, the group goal was clear: students who wanted to succeed needed to help his or her partner to learn. In heterogeneous grouping, due to the different ability levels of two students in a pair, the low ability student gained the assistance they needed from the high ability student to develop their skills to finish the task (Miller, 1993). Besides, when the high ability student explained questions from the low ability student, his or her understanding about the knowledge was deeper than before. Therefore, students in heterogeneous pairs recalled more ideas.

The experimental study conducted by Watson and Marshall (1995) showed that heterogeneous grouping did not benefit student learning more compared with homogeneous grouping. In this experiment, 109 students were randomly assigned to heterogeneous or homogeneous groups based on their pretest scores. After that, cooperative incentives and individual incentives were another two factors that were used to form groups. Thus, four types of groups were formed which were heterogeneous-cooperative incentives groups, heterogeneous-individual incentives groups, homogeneous-cooperative incentives groups and homogeneous-individual incentives groups. It was found that the difference of scores between post-test and pretest in heterogeneous-cooperative incentives groups were similar with those in homogeneous-cooperative incentives groups. Since the factor of cooperative incentives existed in both types of groups, heterogeneous and homogeneous arrangements were factors which influenced post-test. In addition, the differences of scores between post-test and pretest were the same in these two types of groups, therefore, the effects of heterogeneous and homogeneous groupings were the same on college student achievement. The same conclusion was found when heterogeneous-individual incentives were compared with homogeneous-individual incentives. Thus, the results indicated that heterogeneous grouping was not better than homogeneous grouping for enhancing student learning.

In the study by Larson et al. (1984), participants were first trained to learn cooperatively so that they knew what they should do during the process. This same step was taken in a study by Cobb (1999). In this experiment, 100 students were divided according to their GPA, into heterogeneous mixed achievement groups, homogeneous high achievement groups, and homogeneous average achievement groups. Participants took the pretests before the cooperative learning. Group post-tests and individual post-tests were given at the end of learning. Group

post-tests ensured that members were willing to help one another in the same group, so that each member in the same group truly learned the content. After analyzing the scores, the researcher found that homogeneous average achievement and heterogeneous mixed achievement groups learned less than homogeneous high achievement groups because the scores of the first two types of groups was much lower than those of the last type of groups. According to cognitive elaboration theory (Slavin, 2010), expanding new knowledge based on prior knowledge leads to better learning as well as better achievement. Students in high achievement groups had greater prior knowledge than those in other two types of groups. It was easier for them to find new material to expand their knowledge on the basis of prior knowledge. Therefore, students in homogeneous high achievement groups had higher scores than other groups.

Similar to the studies by Larson et al. (1984) and Cobb (1999), Baer's (2003) study examined the effects of heterogeneous and homogeneous groups on student learning. However, in contrast with the conclusion by Larson et al. (1984) which suggested that heterogeneous pairs performed better than homogeneous pairs, Baer (2003) showed that homogeneous groups had better performance than heterogeneous groups. In addition, homogeneous grouping obviously benefited higher and average achievers while low achievers in both types of groups performed quite similarly without big differences. In the experiment, heterogeneous and homogeneous groups were formed on the basis of their scores in the first test. All groups were taught in very similar class environments. The results indicated that homogeneous grouping benefited average and high achievers more, but did not have much positive influence on low achievers compared to students in heterogeneous groups. According to the cognitive elaboration perspective (Slavin, 2010), students who have more prior knowledge can better practice new knowledge based on their prior knowledge. In this study, average or high achiever in homogeneous groups had more

prior knowledge than low achievers; therefore, they can better practice new knowledge while low achievers practice less because their prior knowledge is lower. In addition, low achievers in homogeneous groups got less help and feedback because other members in the same group also had lower level knowledge.

Camara et al. (2007) conducted an experiment to examine if homogeneous and heterogeneous groups were on the basis of GPA, the effects of these two types of group strategies on student learning were similar or different. The results showed that high peer evaluations were obtained by students in heterogeneous groups, but the effects of both types of groups on high achievers were very similar. However, homogeneous groups benefited the performance of low achievers because in homogeneous groups, low achievers felt comfortable and less pressured to share information and ask questions due to their similar ability levels. In heterogeneous groups, because the ability levels of low achievers were much lower than that of others, they may have felt uncomfortable or embarrassed to ask for help or share their own thoughts to others.

The experiment conducted by Larson et al. (1984) showed that individuals performed better if they studied with partners whose academic abilities were heterogeneous. Based on the results of that experiment (Larson et al., 1984), Miller et al. (2012) tested whether that conclusion worked for students in biological labs. Eighty-three undergraduate students and 57 graduate students participating in the experiment formed undergraduate-graduate pairs and undergraduate-undergraduate pairs in the lab by the instructor's intentional assignment. When students did their lab exercise, they were encouraged to learn cooperatively and discuss questions given by the instructor with others. However, they were also required to write down answers to those questions independently. According to the analyses, the authors claimed that

heterogeneous grouping benefited student learning because scores of both undergraduate and graduate students were increased when students were in heterogeneous groups. This finding may be supported by the motivational perspective on learning. During the experiment, the goal of cooperative learning were emphasized which was to try their best to help other members in the same group, because they were evaluated based on the whole group performance (Slavin, 2010). Once they helped each other, they learned better, and had higher scores. However, some steps of the experiment were not clearly described so some questions exist. For example, the authors mentioned that students were deliberately assigned as undergraduate-graduate pairs, but they did not supply more details about it. The performance of a pair with an undergraduate of low academic level and a graduate of high academic level may be different from the performance of a pair with an undergraduate and a graduate both of low academic level. Meanwhile, the cause of the difference may not be that they are grouped by undergraduate-undergraduate or undergraduate-graduate, but the academic levels of graduates. Therefore, the grouping part in this experiment should be described in more details.

Part of an experiment conducted by Tutty and Klein (2008) also examined the effects of heterogeneous and homogeneous grouping on student learning. The ability levels of participants were determined as higher and lower levels by a pretest. Homogeneous lower ability pairs, homogeneous higher ability pairs, and heterogeneous ability pairs were then formed on the basis of pretest scores. After the cooperative learning, a post-test was taken, and the group performance was evaluated. An attitude survey and interview were also conducted. The results suggested that students in homogeneous higher-ability dyads and heterogeneous mixed-ability dyads had much better performance than homogeneous lower-ability dyads while lower-ability students benefited more in heterogeneous groups with higher-ability students than in

homogeneous groups. In heterogeneous groups, lower-ability students could get more help and appropriate feedback when they were confused by questions because according to the social cohesion perspective of learning (Slavin, 2010), students cared about other members' interests as a result of emotional connections among members, and they wanted others in the group to succeed. According to the motivational perspective (Slavin, 2010), group goals in cooperative learning are important in that students are willing to help other members if they are evaluated by the group's performance.

Jensen and Lawson (2011) discussed the relationship among achievements, reasoning ability, group compositions and instruction types (inquiry/didactic). The reasoning ability levels of students were determined by a test before they were assigned to groups solely according to their test scores. A homogeneous group consisted of only high, medium, or low score students, and a heterogeneous group consist of at least one high score student and one low score student. Besides the group composition, another variable was the instruction type. Final exams and attitude surveys were conducted. Detailed results related to group composition indicated that: on high-level exam grades (application of concepts), low reasoners preferred homogeneous groups; on low-level exam grades (knowledge of concepts), heterogeneous groups were preferred when under didactic instructions. The conclusion by the authors was that students with low reasoning ability benefited more when they were in homogeneous groups because they felt more comfortable and less pressure to share their thoughts, and ask for help from other members than in heterogeneous groups.

Table 2

Studies in which groups were formed on the basis of student abilities

Study author(s)	Participants	Grouping factor(s) / Outcome variable(s)	Grouping effects (HET = Heterogeneous, HOM = Homogeneous)
Larson et al.	78 students from introductory psychology courses	Verbal abilities / Vocabulary test	The performance of students with HET ability partners was better than those with HOM partners.
Watson & Marshall	109 students from an introductory life science course at University	Biology achievement test / Biology achievement test	HET grouping did not benefit student learning more compared with HOM grouping.
Cobb	100 junior-level students from nursing program	Cumulative GPA / Nursing test	HOM average achievement and HET mixed achievement groups learned less than HOM high achievement groups.
Baer	137 students from an educational psychology class (age:19-20)	The quiz results / Educational psychology midterm and final examinations	1) HOM groups had better performance than HET groups. 2) HOM grouping benefited higher and average achievers while low achievers in both types of groups performed quite similarly without big differences
Camara et al.	135 students in a university	Cumulative GPA / 1) Student peer evaluations 2) Business final exam grades based on individual performance	1) High peer evaluations were obtained by students in HET groups, but the effects of both types of groups on high achievers were very similar. 2) HOM groups benefited the performance of low achievers.
Miller et al.	140 undergraduate and graduate students at University	Biotechnology abilities / Biotechnology test	1) HET grouping benefited student learning. 2) Students preferred to work in HET groups.
Tutty & Klein	120 students at a state university	Computer abilities / Computer literacy test	1) Students in HOM higher-ability dyads and HET mixed-ability dyads had much better performance than HOM lower-ability dyads while 2) lower-ability students benefited more in HET groups with higher-ability students than in HOM groups.
Jensen & Lawson	160 students at a community college	Reasoning abilities / Biology achievement and reasoning gains test	HOM groups benefited low-reasoning students more.

Table 3

Summary of studies in which groups were formed on the basis of student abilities

	Heterogeneous grouping is more beneficial	Homogeneous grouping is more beneficial	No difference (The effects of heterogeneous and homogeneous grouping is not different)
Student achievement	2	1	1
Student satisfaction	2	0	0

Note: numbers indicate the total number of articles that support the respective results.

Table 2 summarized the studies in which groups were formed by abilities of students. Table 3 shows that four of those studies focused on the relation between grouping and student achievement. Two out of four indicated that heterogeneous grouping, compared with homogeneous grouping, was more beneficial to student achievement. One study showed that homogeneous grouping, compared with heterogeneous grouping, was more beneficial for student achievement while the other one suggested that the effects of heterogeneous and homogeneous groupings on student achievement were not significantly different. From this review of research on the effects of different groupings based on abilities on student achievement, heterogeneous grouping is better for student achievement. This conclusion is consistent with the concept of the zone of proximal development in which less knowledgeable students gain appropriate assistance, thus arrive at a higher level of development (Miller, 1993). In heterogeneous ability groups, because students are at different levels of abilities, high level ability students help low level ability students to improve their performance so that the whole group performance will be improved. In addition, this finding is supported by the theory of Troyer and Youngreen (2009) who believe that conflicts among group members can increase group creativity and help members to have better performance. The conclusion is also consistent with the motivational

perspective. Once goal structures are emphasized, students would try their best to help other members in the same group because they are rewarded based on group performance (Slavin, 2010). In heterogeneous groups, low level students can gain better help and appreciate feedback to improve their studies. In the studies of Larson et al., (1984) and Miller et al. (2012), the number of group members was two, the smallest number of group members. The positive effects of heterogeneous grouping on students' achievement are more obvious when the group membership is small.

Table 3 also indicates that heterogeneous grouping was more favorable for student satisfaction and attitude towards their learning and other members in one group. No studies indicated homogeneous grouping was more favorable for to student satisfaction. According to motivational perspectives (Slavin, 2010), if students are rewarded or evaluated by group performance rather than separate individual performance, in order to achieve their personal goals, students will help other students in the same group. In heterogeneous groups, students from different ability level are more motivated to answer questions and explain their understandings. For example, if low ability levels students are confused by a question, high ability level students can explain it to them. However, in homogeneous groups, if one student has questions, other student may also be confused by them, thus they may not be able to help each other because their ability levels are similar.

Table 4

The relations between different ability levels and groupings

	Heterogeneous grouping is more beneficial	Homogeneous grouping is more beneficial	No difference (The effects of heterogeneous and homogeneous grouping are similar)
High ability students	1	3	1
Medium ability students	1	2	1
Low ability students	3	2	1

Note: numbers indicate the total number of articles that support the respective results.

The summary in Table 4 indicates that high and medium ability level students benefitted more from homogeneous grouping while low ability level students benefitted more from heterogeneous grouping. High and medium ability level students in homogeneous groups are the students whose abilities are average or above average. When studying together, they could use their time to finish their own part of the whole task, and did not have to spend time in explaining or answering questions to help those who did not understand in order to finish the group task. According to cognitive elaboration theory (Slavin, 2010), high and medium ability level students have more prior knowledge which benefits their learning of new knowledge. However, heterogeneous groups benefitted students with low ability. According to Slavin (2010), their ability levels were low so that they needed more explanations in order to finish tasks. they were in heterogeneous groups of cooperative learning, high or medium ability level students offered more help and explanations to them because according to the motivational perspectives (Slavin, 2010), all students in one group in cooperative learning, were evaluated by the group performance rather than individual performance, if students want to be high evaluated, they have

to promise other students in the group also learn well. Therefore, in heterogeneous groups, high ability students were willing to try their best to help other members. In addition, According to Vygotsky (1987), with the assistance from high ability students, low ability students in heterogeneous groups may develop their skills which lead them to a higher level of development.

Studies of grouping based on race and culture

Usluata (1997) conducted an experiment to compare effects of heterogeneous and homogeneous grouping on learning of college-level students. Students in a business course with the goal of helping students to develop intercultural communication skills were assigned to heterogeneous and homogeneous learner groups on the basis of culture identities. Based on the experimental results, in heterogeneous groups, most students felt that new ideas, different perceptions were easier to be generated when they shared information and learned from students who had different experiences. In addition, students with different experiences and background felt less social bias when they communicated with other students in the groups.

Oetzel (1998) examined the effect of grouping composition (homogeneous/heterogeneous) in an experiment conducted with European American students and Japanese students. The students were randomly assigned to groups with 4 people, with groups having (1) 4 European American students; (2) 4 Japanese students, or 3 Japanese students plus 1 European American students; or (3) 2 Japanese students plus 2 European American students. The first and second types of groups were denoted as Euro American groups and Japanese groups, with both being homogeneous. The third type of group was denoted as a heterogeneous group. After the grouping, the students were required to make a group decision on whether to discipline a student on an exam-cheating case. After analyzing the discussions, Oetzel found that heterogeneous groups

had more conflicts, thus tend to reach majority decisions, rather than consensus decisions. Also, the heterogeneous groups had more imbalanced turn takings, which reflect the inequality of participation of decision making. Overall, heterogeneous groups experienced more difficulties in interactions and decision makings, because they had different levels of knowledge and thoughts. The lack of conflict in homogeneous groups can be explained as a result of efficient communication, or of less sharing of ideas.

Shen (2003) focused on the group composition with respect to heritage learners and non-heritage learners in a written Chinese course. "Heritage learner" here means that the learner is raised in a Chinese-speaking family, and the non-heritage learner is raised in an English-speaking family (Shen, 2003). In this paper, the author investigated the achievement of the heritage learners. In the first-year Chinese course, 17 students were mixed with non-heritage students in a regular class section which took one year to finish, and hence referred as "heterogeneous group"; the other 15 students were assigned to a single "accelerated" class section which took one semester to finish, and hence referred as "homogeneous group". It was established that these students had similar academics background before they took two tests after the course, including one vocabulary test and one SAT II Test with listening. The results showed that with heritage students, the homogeneous groups had better performance than the heterogeneous group, even though the homogeneous students took the course for half less time than the heterogeneous students. The conclusion in this study was that the heritage students achieved more if they were assigned to a homogeneous group with other heritage students because they felt less pressure to share their thoughts. However, this study conducted the research with different groups of heritage students and results applied just to heritage students

because all 32 participants were heritage students. It did not conduct the research on the effects of different groupings on the achievement of non-heritage students.

Table 5

Studies in which groups were formed on the basis of race and culture

Study author(s)	Participants	Grouping factor(s) / Outcome variable(s)	Grouping effects (HET = Heterogeneous, HOM = Homogeneous)
Usluata	151 students at Bogazici University	Cultures / Evaluation forms & communication skill test	1) HET grouping benefited students 2) Most students supported HET group work. 3) Less social biases in HET groups.
Oetzel	148 international students	Cultures / Decision-making test	HET groups had more conflicts when making decisions.
Shen	49 students at the University of Virginia	Cultures / Vocabulary test & SAT II	The HOM groups performed better

Table 5 summarizes the studies in which groups were formed by race and culture of students. There was one study (Shen, 2003) indicating homogeneous grouping as more beneficial for student achievement. In homogeneous groups based on race and culture, students with the same back ground were easy to communicate because the same language or culture so that the interactions among members were increased. According to cognitive-developmental and cognitive-elaboration theoretical perspectives, the interactions among students improve student achievement, because those interactions could expand their prior knowledge (Slavin, 1995, 2010). Table 5 also shows there were two studies on the relation of student satisfaction and grouping. One study (Usluata, 1997) supported heterogeneous grouping as more beneficial for student

satisfaction while the other one (Oetzel, 1998) supported homogeneous grouping as more beneficial for student satisfaction. In Usluata's study, students could create new ideas because of the different experiences of members. In Oetzel's study, homogeneous groups had similar backgrounds, language and cultures, which made group members feel less pressure when communicating with others.

Studies of grouping based on learning styles

Learning styles was defined by Keefe (1987) as "the characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (p.5) while Kolb (1984) defined it as the preferred method for students to learn. Students in heterogeneous groups which are formed on the basis of different learning styles feel less pressure or fear when communicating with other members (Miller & Polito, 1999; Romero-Simpson, 1995). In this section, the studies were reviewed in which the effects of heterogeneous and homogeneous groups on the basis of learning styles on the learning of college students were compared in the same experiment.

Ross (1980) conducted an experiment, to examine homogeneous and heterogeneous groupings and the role of achievement styles on student achievement. Because of the complexities of the interaction among achievement styles, tasks and groupings, it was difficult to decide which group strategy was preferred. Achievement styles were defined by Ross (1980) as follows: "Achievement styles are based on combinations of the Achievement via Conformance (Ac) and Achievement via Independence (Ai) scales of the California Psychological Inventory." (p.216). In this study, Ac and Ai were the two factors combining achievement styles. Since Ac includes high Ac and low Ac, Ai includes high Ai and low Ai there were four types of groups on

achievement styles which were high Ac- high Ai groups (HH), high Ac- low Ai groups (HL), low Ac-high Ai groups (LH), and low Ac- low Ai groups (LL) (Ross, 1980). Every student fitted into one of the following group: high Ac/high Ai (HH), high Ac/low Ai (HL), low Ac/high Ai (LH), and low Ac/low Ai (LL). Additional to the achievement styles, Ross stated that the task demand types would also influence the performance of the students in the different groups which were formed by achievement styles. The task demand could be either decision-making (DM) or grading-feedback (GF). The experiment exploring the relationship among achievement styles, tasks and groupings were conducted on 247 freshman and sophomore students. These students were specifically chosen from 528 Ac/Ai tested students so that the participants had either high or low scales on both Ac/Ai style (no intermediate score recipients). The participants were then assigned to groups based on their Ac/Ai scores. 30 groups were homogeneous groups, including 9 each HH and LL groups and 6 each HL and LH groups. Twelve groups were heterogeneous that included all types of students with respect to achievement styles. The students were then given 2 DM exercises and 2 GF exercises, which were all group-based. In the DM exercises, a group had to agree on the ranked order of factors in a problem; in the GF exercises, a group had to complete a productive thinking project. The performance of the students in the experiment was on self-evaluation basis. The students responded to questionnaires on their contribution, trust, acceptance, and satisfaction after each exercise or the whole course. The conclusions were drawn from the statistical correlations among the performance scales, through MANOVA analysis. Ross found that heterogeneous groups increased the effectiveness of HH students on DM tasks while homogeneous groups did the same on GF tasks; HL students preferred homogeneous groups all the time; LL students preferred heterogeneous groups all the time. Ross concluded that

the interaction among achievement styles, tasks and groupings were very complex, with no universal preferences on either grouping strategy.

Miller and Polito (1999) explored the effect of group composition which was on the basis of student preferred learning styles indicated that grouping teams formed on the basis of learning styles had no effect on student learning. In the study, participants were tested by the *Group Embedded Figures Test* (GEFT) which was a standardized instrument to assess students' preferred learning style. The high, middle, and low scores in GEFT indicated that their preferred learning styles were field-independent, field-neutral and field-dependent (Dyer and Osborne, 1996). The researchers in this study grouped 90 students who took the GEFT before the group composition according to their scores. Therefore, there were three types of homogeneous groups which were the high-score, middle-score, and low-score groups and one type of heterogeneous groups which was mixed-score groups that consisted of students with all range of scores. The performance of the students was evaluated by multiple metrics including course grade, team work grade, class attendance, team activity attendance and satisfaction with the team. The results of the study indicated that in final course and teamwork, students in homogeneous groups, formed on the basis of the field-neutral teams, attained the highest grades. Then the students on homogeneous field-independent teams, heterogeneous mixed teams, and homogeneous field-independent teams had scores from higher to lower. The results did not support that heterogeneous teams could get higher grades. In addition, the results also reported in terms of satisfaction with team activities, the teams attaining mean satisfaction scores from higher to lowest were homogeneous field-independent teams, heterogeneous mixed teams, homogeneous field-neutral teams, and homogeneous field-dependent teams. Therefore, homogeneous learning style teams do not have more satisfaction with team activities. Moreover, in that the rate of

activity attendance of teams from highest to lowest were field-neutral, field-dependent, field-independent, and mixed, the rates of activity attendance of homogenous groups were larger than those of heterogeneous groups. However, statistically significant differences among groups were not detected. According to the observation of the researchers, students in the mixed group only engaged in very limited discussion and distanced themselves from other members. These findings could be supported by the theoretical concept that different perspectives may raise conflicts among group members (Troyer & Youngreen, 2009). In addition, the conflicts and cooperation which is raised by students' personal identity and social identity in heterogeneous group benefits group achievement (Brewer, 1991; Miller & Polito, 1999). This theoretical perspective explained the reasons that field-neutral teams attained higher grades in final course and teamwork.

Maloof and White (2005) conducted a similar experiment to that of Miller and Polito (1999), exploring the effect of group composition on student outcomes. They found that groups formed on the basis of students' preferred cognitive learning style had no effect on student achievement. Preferred cognitive learning style also defined as perceptual modality (auditory, kinesthetic, visual, or tactile) which was one category of learning styles (Keefe, 1987). In this study, students took the Learning Style Assessment to determine their preferred cognitive learning styles. Participants in homogeneous groups consisted of students with similar preferred learning styles while those in heterogeneous groups consisted of students with diverse preferred learning styles. Student achievement was measured as the difference between scores on a pre-test and a post-test tool with the same content at the beginning and end of the semester. After analyzing the scores of the two tests, no difference was found when heterogeneous and homogeneous learning style groups were compared with each other. Therefore, the results

indicated that grouping on the basis of cognitive learning style had no effect on student achievement. In this two-year experiment, motivation and social cohesion were not changed during the two years, but cognitive elaboration was taught only in the first year. However, the results were the same: grouping on the basis of cognitive learning style had no effect on student achievement.

Kinchin and Hay (2005) conducted an experiment to examine the following question: if students understand and organize new concepts in a course in different ways, grouping of students should be based on the students with similar understanding (homogeneous grouping) or different understandings (heterogeneous grouping). The findings indicated that students in heterogeneous groups made significant improvements compared to students in homogeneous groups. In order to examine the learning styles of students, each student, in a genetics course, was required to draw a concept map before the treatment. The map could be a spoke type, a chain type or a net type. Students who drew similar concept maps were thought to have similar learning styles and were assigned to a homogeneous group. Students who drew different maps were assigned to a heterogeneous group. However, no grouping standards were provided to students. After that, students in the same groups were allowed to discuss and draw a final version of the concept map and submit a group version of the concept map. The outcome of a group was simply defined as the appropriateness of the concept map. A gain score was calculated by comparing the individual concept map and the group concept map. The results showed that gain scores increased in heterogeneous grouping, and decreased in homogeneous grouping. In other words, the students understood the concepts better if they were in heterogeneous groups and communicated with people with different understandings. This finding can be supported by the theoretical perspective related to interaction. Both cognitive elaboration theorists and cognitive

developmental theorists believe that interactions among students on appropriate tasks will benefit their learning (Vygotsky, 1978; Slavin, 2010). As they were in the same group, they were rewarded by the group achievement, therefore, that interaction with other students made students explicitly share and explain their understanding to other members in the groups. In addition, in a heterogonous group, conflicts among group members can increase group creativity and help members to perform better (Troyer & Youngreen, 2009). In this study, students in heterogeneous groups had opportunities to learn from each other and gained more creativity and skills because of conflicts and discussion compared with homogeneous groups.

An experiment conducted by Kyprianidou et al. (2012) explored the effect of learning-style-based heterogeneous grouping system on student attitudes towards collaboration. Results indicated that heterogeneous groups which were formed on the basis of learning styles were beneficial for attitudes of students towards collaboration. Student learning styles were first assessed with the *Raudsepp Problem Solving Styles Inventory* (Raudsepp, 1992). Then the students were assigned to heterogeneous groups by an algorithm to find optimal group variations in order to reach maximum heterogeneity in all possible group compositions. However, the algorithm was heuristic so the best group variation was not guaranteed. The experiment was conducted with 50 senior students in a course "Design and Evaluation of Educational Software". The students' attitudes were assessed after the course by questionnaires. From the results, the majority of the students supported the group composition and admitted that the collaboration was satisfactory in this course. Therefore the conclusion was that this heterogeneous grouping system was beneficial to student attitudes towards collaboration. The reasons for this conclusion may be students in heterogeneous groups could gain complementarities of thinking, could gain group creativity. According to Slavin (1995), when students share information and answer questions

from others in heterogeneous groups, they improve their attitude to learning and their attitude toward other students. However, the lack of control groups, the size of the sample and the ambiguity of the grouping system make the conclusion questionable.

Table 6

Studies in which groups were formed on the basis of learning styles

Study author(s)	Participants	Grouping factor(s)	Outcome variable(s)	Grouping effects (HET = Heterogeneous, HOM = Homogeneous)
Ross	247 students at an introductory psychology class	Achievement styles	Decision-making test & grading feedback test	HET and HOM groups increased the effectiveness of some students
Miller & Polito	90 students at Iowa State University	Learning styles	Agronomy test	No effect on student achievement.
Maloof & White	131 students in biology laboratory classes	Learning styles	Biology laboratory achievement test	No effect on the introductory biology course.
Kinchin & Hay	12 students on a program for nurses	Learning styles	Concepts test	The students understood the concepts better in HET groups.
Kyprianidou et al.	50 senior university students	Learning styles	Students' attitudes	HET grouping benefits student attitudes towards collaboration.

Note: numbers indicate the total number of articles that support the respective results.

Table 7

Summary of studies in which groups were formed on the basis of learning styles

	Heterogeneous grouping is more beneficial	Homogeneous grouping is more beneficial	No difference (The effects of heterogeneous and homogeneous grouping are similar)
Achievement	2	0	2
Satisfaction (attitude)	1	0	0

Note: numbers indicate the total number of articles that support the respective results.

Table 6 summarizes studies in which groups were formed by learning styles of students. Table 7 shows that for student achievement, two studies supported heterogeneous grouping as more beneficial while no study supported homogeneous grouping as more beneficial. The results are supported by the theory that groups in heterogeneous groups can decrease fear, increase more opportunities for group discussion and improve the quality of problem solving (Miller & Polito, 1999; Romero-Simpson, 1995). These results are also supported by the theory that different perspectives among members raise the creativity which benefits student achievement (Troyer & Younggreen, 2009). Because students are rewarded based on their group performance, different students are willing to share thoughts, answer questions, and offer help to other members. However, two studies claimed the effects on achievement of heterogeneous and homogeneous grouping were similar. The experiment of Ross indicated that heterogeneous grouping was more beneficial for some tasks while homogeneous grouping was more beneficial for some tasks. Table 8 also shows that heterogeneous grouping was more beneficial for attitudes of students toward learning and other students in the same group. This finding is supported by the theory that when students share information and answer questions of others in heterogeneous groups,

they improve their attitude to their learning and their attitudes toward other students (Slavin, 1995).

Studies of grouping based on personal characteristics

Koppenhaver and Shrader (2003) conducted an experiment in which groups formed by personality styles. The results indicated that there was no difference in student performance when heterogeneous and homogeneous groupings were compared with each other. However, the reasons were not found in the study.

Schullery and Schullery (2006) investigated group composition with respect to personality type, according to Jungian Myers-Briggs Type Indicator (MBTI) (Myers et al., 1998). MBTI is an inventory which assesses student personalities so that instructors can identify student preferred behaviors (Myers et al., 1998). Schullery and Schullery focused on multiple factors that were derived from MBTI to decide the group composition preference. The experiment in this study was conducted with a relatively large sample: 394 students in 16 sophomore and junior business courses. The students were divided into 102 groups of 2 to 6 students, and were required to complete collaborative group projects. The authors claimed that the groups were assigned in order to get a diverse distribution of heterogeneity, though no detailed procedures are described. The number of the grouping factors the authors analyzed was quite large. According to Schullery and Schullery (2006), the MBTI indicator has four dimensions: “Extravert/Introvert (E/I) attitude for expending and receiving energy, Sensing/Intuiting (S/N) function for gathering information, Thinking/Feeling (T/F) function for making decisions, and Judging/Perceiving (J/P) attitude toward the external world” (p. 546). The authors investigated the following variables: single-scale MBTI homogeneity variables that included only one dimension in MBTI; average

MBTI homogeneity that was the average of all four single-scale variables; total MBTI heterogeneity that described the minority proportions in the group; and two other variables, temperament heterogeneity and argumentativeness heterogeneity that were related to MBTI indicators. The heterogeneity of the groups was defined based on these variables, and student outcomes of self-perceptions, instructor's perceptions, satisfactions and grades were evaluated. The authors explored correlations between variables and the outcomes by groups. The results indicated that with respect to some variables, homogeneous groups were more beneficial for student outcomes while heterogeneous groups were more beneficial for student outcomes with other variables.

Stapleton (2007) also conducted research on the effect of heterogeneous and homogeneous grouping based on MBTI. In the experiment, 417 students were assigned to 103 groups of four. These groups were constructed according to specific dimensions in MBTI so that 55 of the groups were homogeneous groups and 48 of the groups were heterogeneous groups. The students were then required to complete two group projects, NASA "Lost on the Moon" decision task and Winter Survival Exercise. The outcome of the groups was evaluated based on the scores achieved on these tasks. The results of the experiment showed that the heterogeneous groups performed much better on the Winter Survival Exercise, but not on the "Lost on the Moon" task. The author concluded a preference of heterogeneous grouping, but it is important to note that the outcome was only obtained on two decision-making exercises.

Table 8

Studies in which groups were formed on the basis of personal characteristics

Study author(s)	Participants	Grouping factor(s) / Outcome variable(s)	Grouping effects (HET = Heterogeneous, HOM = Homogeneous)
Koppenhaver & Shrader	500 undergraduate students	Personal characteristics / finance course test	No difference
Schullery & Schullery	394 students at a college	Personal characteristics / Business course test	1) Both HOM groups and HET groups were associated with positive effects. 2) The personality of students decided the preference of group strategies.
Stapleton	417 undergraduate students (age:18-43)	Personal characteristics / Problem-solving task	1) The HET groups performed significantly better on the Winter Survival Exercise. 2) HET groups were not better in the "Lost on the Moon" task.

The summary in Table 8 shows that when college students were grouped by personal characteristics, there were two studies supporting of heterogeneous grouping. Schullery and Schullery (2006) indicated that both heterogeneous and homogeneous groupings based on personal characteristics had positive effects on student outcomes because diverse personal styles decrease students' fear and make students actively join to group discussions (Romero-Simpson, 1995). Within the motivational perspective, students with different personal styles are willing help other members to learning and make decisions because they are evaluated by the whole group performance (Slavin, 2010). However, Stapleton (2007) indicated that heterogeneous grouping which was based on personal characteristics had a positive influence on some tasks, but not all tasks. The finding of the study conducted by Koppenhaver and Shrader (2003) is not supported by the theory that different personal styles in heterogeneous groups benefit for the interactions and the discussions among students.

Table 9

Summary of effects on student achievement and satisfaction based on different groupings

	Heterogeneous grouping is more beneficial	Homogeneous grouping is more beneficial	No difference (The effects of heterogeneous and homogeneous grouping are similar)
Achievement	6	3	5
Satisfaction	4	1	0

Note: numbers indicate the total number of articles that support the respective results

Four studies by Jensen and Lawson (2011), Ross (1980), Schullery and Schullery (2006), Stapleton (2007) and Tutty and Klein (2008) are not included in the summary because the results in each study indicated heterogeneous groups benefit for some tasks while homogeneous groups benefit for other tasks. Some studies summarized the effectiveness of grouping on both student achievement and student satisfaction while some studies only investigated the effectiveness of grouping on either student achievement or on student satisfaction. Therefore, the total number in table 9 does not represent the total number of studies. A summary of the reviewed studies indicates that for student achievement, in the fourteen studies, six supported heterogeneous grouping as more beneficial, three supported homogeneous grouping as more beneficial, and five studies showed that there was no significant difference of effects between heterogeneous and homogeneous grouping. Table 9 also shows that student satisfaction was more favorable in four studies associated with heterogeneous grouping. According to the motivational perspective of student learning (Slavin, 2010), students in cooperative learning are willing to help other members because they are rewarded based on group performance. If one wants to be highly estimated or rewarded, he or she must help other members to learning. Although conflict occurs

in heterogeneous grouping, such diversity in the group helps members perform better. In addition, due to the zone of proximal development, less skilled students get more help and feedback when they ask questions benefitting their learning. However, students in homogeneous grouping also improve their achievement because they are at similar level, have similar backgrounds and therefore feel more comfortable to share and express their own thoughts to other members. The results in Table 9 suggest that there are advantages and disadvantages of heterogeneous and homogeneous grouping for student learning.

CHAPTER 5: DISCUSSION

According to Slavin (2010), in cooperative learning environments, instructors organize students into small groups to work together in order to help others in the same group to learn academic content. Cooperative learning improves student achievement (Slavin, 1980, 1995, 2010). Four theoretical perspectives including motivational perspective, social cohesion perspective, and cognitive elaboration perspective support the effectiveness of cooperative learning (Slavin, 2010). Grouping is a very important element of cooperative learning (Slavin, 2010). Interactions among students in the group benefit student learning. Interactions provide many opportunities for members in the group to share information, express their own thoughts, discuss or even argue about the thoughts of other members (Miller, 1993; Slavin, 1983). Interactions with more knowledgeable peers provide the assistance to less knowledgeable students and help them to develop skills. Members in the same group are positively and negatively influenced by each other (Miller, 1993; Vygotsky, 1978). Individuals in groups have personal identity and social identity (Brewer, 1991; Miller & Polito, 1999). They want to be similar with others while they also want to be different from others (Brewer, 1991; Miller & Polito, 1999), then conflicts among members may increase group creativity and help members to perform better (Troyer & Youngreen, 2009). Heterogeneous and homogeneous grouping are the two main types of grouping. In that heterogeneous grouping is popular when cooperative learning is used, people think that the effects of heterogeneous grouping on college-level students are assumed to be always positive, or even better when compared with effects of homogeneous grouping (Watson & Marshall, 1995).

This review addressed the question “what are the effects of different grouping strategies (homogenous and heterogeneous) on learning of college-level students in cooperative learning contexts?” Nineteen studies from 1980 to 2012 related to the research question were identified. Studies were reviewed based on the independent variables that formed different groups. In these studies, the variables were abilities, race and culture, learning styles, and personal characteristics.

Studies in which groups were formed by student abilities suggested that heterogeneous grouping was more beneficial for student achievement. This conclusion is supported by the theoretical perspective that in interaction with more skilled students, less skilled students can get the help need to develop their skills and enhance the achievement of the whole group (Miller , 1993; Vygotsky, 1978). This conclusion is also supported by the theoretical perspective in which conflict among students at different levels may result in creativity of the group (Troyer & Youngreen, 2009). However, the conclusion that heterogeneous ability groups resulted in student satisfaction with their learning and their attitude towards other students cannot be related to theoretical perspectives. Students with high and medium level ability can gain more assistance from homogeneous groups while students with low level ability can gain more assistance from heterogeneous groups. This may be because interaction with more skilled students, low level ability students can gain the help needed. No clear conclusion could be obtained from studies in which groups were formed by race and culture, because there was only one study supporting each aspect of possible conclusions. The number of studies supporting heterogeneous grouping as beneficial for student achievement and satisfaction was the same as those supporting homogeneous grouping as beneficial. Studies in which groups were formed on the basis of learning styles suggested heterogeneous grouping was more beneficial for student satisfaction with their learning and their attitudes toward other students. However, studies did not show

heterogeneous grouping as more beneficial for student achievement. In studies in which groups were formed by personal characteristics, heterogeneous grouping was found to be more beneficial, but results differ based on different experiments. Grouping based on personal characteristics may affect learning of college students; however, the positive and negative influence on students' learning was not demonstrated. The results were not well explained by theories in this review.

Overall, six of fourteen studies were found in support of heterogeneous grouping as beneficial for student achievement, and four of five studies showed that heterogeneous grouping was beneficial for student learning and their attitude towards other students. The diversity in heterogeneous groups provides different perspectives for students which contribute to their creativity, and achievement (Troyer & Youngreen, 2009). In addition, students in heterogeneous groups had the possibility to help other students in the same group because in cooperative learning, individuals are evaluated or rewarded on the basis of group performance (Slavin, 1995). Three of fourteen studies were found supporting homogeneous grouping as beneficial for student achievement, and only one of five studies showed heterogeneous grouping as beneficial for student satisfaction. Because students in homogeneous groups are at similar ability level, they feel more comfortable sharing their thoughts and communicating with other members, which benefits their learning.

Limitations

There are several limitations that apply to this review of the effects of heterogeneous and homogeneous groupings on cooperative learning. The first limitation is that the number of empirical studies that focus on groupings and student learning at the college level is limited. The

number of studies related to the research question is thus limited. The second limitation of this review is that the basis for grouping in these studies differed across studies. This led to difficulties in generalizing a common finding across the studies. The third limitation is that although the studies in this review described effects of heterogeneous and homogeneous grouping on learning, many of the reviewed studies did not fully explain the basis for obtained results. A final limitation is that it was difficult to relate findings of some studies to concepts and theories in the literature.

Conclusion

The findings of this study suggest the need for more research examining the effects of heterogeneous and homogeneous grouping on learning of college students. More experimental studies should be conducted comparing effects of different groupings because the available number of studies comparing effects of different groupings on college student learning is limited. Further, student learning ability is an important factor related to the study of grouping and more research should focus on this factor. In addition, grouping research should also focus on how groupings formed on the basis of personal characteristics affect student achievement and satisfaction. Slavin (1995, 2010) has proposed four main theories supporting cooperative learning, and when experiments focus on the effects of grouping on cooperative learning, results should be more clearly linked to theories. Future research should connect experimental studies not only with cooperative learning theories but also grouping theories which could support findings of the studies.

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