

“United we stand, divided we fall”: Learning from Experiences of Group Work in Information Technology

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Abstract

Learners of programming need to master group work skills. This paper reports on a field study of group work in Information Technology (IT) classrooms. The study employed two field techniques: a questionnaire and journals kept by student teachers throughout the semester. IT student teachers participated in the initial questionnaire, which investigated their previous experience of working in groups. Student teachers' journal entries considered provided detailed descriptions of their individual experiences of working in groups while implementing group work in various IT situations. Data illustrate how and what student teachers learnt about group size, individual responsibility, some consideration of the various roles they played within their group and handling conflict. Analytical discussions of these experiences point to ways in which this knowledge can be applied to ultimately support teachers in helping their learners to apply group work skills effectively in IT classrooms.

Keywords: Group Work, Information Technology, Teacher Training, Experience, Roles, Handling Conflict.

Introduction

These days, programming projects are growing tremendously in size and complexity (Smarkusky, Dempsey, Ludka, & de Quillettes, 2005). This results in groups of programmers having to work together to solve problems and develop solutions, and programming groups increasingly being used as strategic work units in most IT companies (Potter & Blathazard, 2002). Industry consequently highly values employees who are able to work cooperatively, and IT graduates are expected to be able to work together well in groups as part of their required professional skills (Klassen, 2001; McKinney & Denton, 2005).

In the South African context where this study took place, programming and problem solving form part of the new subject Information Technology (IT), which has been approved in the Further Education and Training phase (Department of Education, 2005). Learners in this subject are required to develop the necessary “social skills, time management, resource management and group dynamics” to “co-operate, assist one

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another, divide work, and combine individual contributions into a single composite assessable product” (Department of Education, 2003, p. 40). On the other side of the globe, as part of educational reform in Hong Kong, learners are expected to be well equipped with essential cooperative and communication skills, “so that they can be responsive to the changing requirements of the workplace” (Ng & Ma, 2002, p. 1165).

When students work together with their peers in groups, it contributes to conceptual learning and the knowledge construction process when they consider alternative viewpoints on problem solution, thus creating possibilities for the re-construction of their own perceptions and answers (Nuutila, Törmä, & Malmi, 2005; Van Gorp & Grissom, 2001).

Smarkusky et al. (2005) believe that during the process of actively thinking, working together to construct problem solutions and then designing a program, group projects provide learners with opportunities to share and explore ideas, learn new concepts, expose different points of view, and experience the satisfaction and challenges of working with others. Working together in groups not only nurtures and develops these skills, “but also promotes deep learning through interaction, problem solving and dialogue” (Sudweeks, 2003, p. 1440). Exposure to these kinds of opportunities encourages cooperation between students, which Klassen (2001) considers to be one of the attributes of good teaching practice in undergraduate education.

Specifically in the IT education milieu, various forms of cooperative learning have been widely researched and are now accepted as “part of the 21st century educational lexicon” (Whatley, Bell, Shaylor, Zaitseva, & Zakrzewska, 2005, p. 34). These important teaching-learning strategies produce increases in students’ learning skills, improve student motivation to learn and have significant positive effects on student performance and attitudes towards instructional content (Beck, Chizhik, & McElroy, 2005; Gillies, 2006; Klassen, 2001; McConnell, 2005; Soh, 2006). Many of these advantages represent transferable skills that influence the ways in which students learn - not only when cooperating in groups, but also for individual learning.

This is specifically the case for learners from minorities and/or with special needs in the classroom. A case in point is a study reported on by Ferbar and Trkman (2003, p. 345) where 53 minority student teachers “who worked cooperatively significantly outperformed those who worked individually.”

It is, however, crucial to understand that the attributes of teachers’ contributions are of key importance to make the cooperative learning encounter constructive for all learners (English & Yazdani, 1999). Teachers promote interactions between learners during group work that leads to the type of thinking and problem solving that is necessary to involve them in the learning process (Gillies, 2006; Gillies & Boyle, 2005). Research referred to by Gillies (2003) demonstrates the need for training teachers in the development and implementation of cooperative learning skills. Such training not only adds to the advantages of this instructional approach, but also empowers teachers to help their learners in the IT classroom to utilize group work skills effectively.

For the remainder of this paper, we start by offering a review of relevant literature in the next section. The research methodology used to carry out the research is then briefly described. The first set of results to be reported on, investigated IT student teachers’ previous experience of group work by means of an initial questionnaire. We then report on students’ preliminary views going into the group work, some of what they experienced during the semester and finally, what they learnt about the assumption of various roles within the group and handling conflict. Analytical discussions of these experiences point to ways in which this knowledge can be applied to ultimately support teachers in helping their learners to apply group work skills effectively in IT classrooms. An indication of the importance of the study is presented, finally followed by conclusions.

Literature Review

Researchers often use the terms ‘cooperative’ and ‘collaborative’ interchangeably when referring to group work (Mentz & Goosen, 2007). Both the cooperative and collaborative approaches involve groups of learners working together to achieve an outcome and assigning specific tasks (Panitz, 1996; Whatley et al., 2005). We will briefly point to some of the distinctions that can be drawn between these two approaches to learning.

Cooperative learning usually involves arranging for opportunities where a small number of learners work closely together in an effort to maximize their own and their group members’ achievements (Beck et al., 2005; Johnson & Johnson, 2005, 2006; McGarry & Granger, 2002; Ng & Ma, 2002). It is an activity that is directed at the effectiveness with which the main learning task can be systematically divided between group members (Dillenbourg, Baker, Blaye, & O’Malley, 1996; Dillenbourg & Schneider, 1995) in order to optimally utilize the various resources within the group (Mentz & Goosen, 2007). Each member of the group is independently responsible for a portion of the problem solving.

Whereas cooperative work involves the accomplishment of a specific goal or the development of an end product (Panitz, 1996), collaborative learning focuses more “on the process of working together on a communal task” (Mentz & Goosen, 2007, p. 331). When working collaboratively, group members engage in a coordinated effort to share in the synchronous and interactive creation of a joint solution to the problem at hand (Dillenbourg et al., 1996; Dillenbourg & Schneider, 1995; Whatley et al., 2005).

Teachers experienced in the use of group work know that the promotion of successful cooperative learning “does not just happen” (Sudweeks, 2003, p. 1440) - you cannot simply group learners and hope that they will work together well (Gillies, 2003). Johnson and Johnson (2005) explain that group work requires a number of specific key elements in order to be effective:

- Group members should be linked in that they cannot individually succeed unless they all do (positive task interdependence),
- each group member is expected to be responsible for making their own personal contributions to the group and learning (individual accountability),
- reflection needs to take place about how the group is functioning (group processing),
- group members are expected to use interpersonal and small-group skills that would facilitate learning when helping each other as they work on their task, such as assuming a leadership role and effective communication (social skills), and
- constructive face-to-face interaction ought to be exhibited.

It is common practice to allocate various roles to group members, the main aim of these roles being the assignment of different responsibilities to group members and determining how group members are to act and/or function with-in the group (Smarkusky et al., 2005). In this way “poor drivers” can be avoided - they usually have domineering personalities, leading to them not knowing how to delegate responsibilities, but instead want to do everything themselves. The opposite would be students who become “free riders”, avoiding responsibility and/or making contributions by letting others handle all the work (Nuutila et al., 2005).

The most often mentioned roles that can be assigned to members include a leader and researcher (Wheeler, 1994). The scribe/recorder/secretary is responsible for documenting the group conversation and providing the group consensus solution for the problem (Potter & Blathazard, 2002). Other positions in a group mentioned by Grissom and Van Gorp (2000) are the facilitator, in charge of encouraging everyone to participate, and the speaker/presenter, who presents the group’s answer to the class. The roles of a planner, to outline where and how the group is proceeding through the assignment, as well as an evaluator, to elicit critiques (Gross Davis, 1999),

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can be added. It is necessary to teach students how to act in each role, how to take up responsibility, how to share roles, how to define group learning goals, divide tasks and communicate with each other (McWhaw, Schnackenberg, Sclater, & Abrami, 2003; Nuutila et al., 2005).

Group size could be as small as two members, to as large as 15. The size of the group should be dependant on the maturity of the group, the style of the leader and personalities of group members (Barker, Wahlers, & Watson, 2001). A group size of 4 to 5 persons is supported by Watkins (2004), as the possibility of free riding increases significantly with additional members added to the group. McAllister (1995) agrees, based on literature, that small groups of learners are preferable to larger groups. In groups of this size, learners have more opportunities to express their opinions and offer ideas. Shy or quiet learners are more likely to receive emotional support in smaller groups, and learners are generally more confident. The administration of smaller groups also requires less expertise.

Research Methodology

The students in this study were third-years in an undergraduate B.Ed degree, majoring in Information Technology. All student teachers (N=10) taking various modules within the IT curriculum for the third year formed the population for the study. As only this small number of students take modules within the Information Technology section of the curriculum on the campus where this research was carried out, it was not possible to get a larger sample. As the data population on which this paper is based is not sufficient from a standard statistical perspective, the authors have opted to report individual responses rather than aggregates.

At the start of the semester in which the focus would be on group work, all students completed a questionnaire, which gauged their previous experience of group work. However, due to some students repeating modules from previous years etc., only four of the original 10 students who had completed the initial questionnaire, took all the required modules for the third year. In order to ensure a uniform experimental environment, only these four students were used as a case study in the second leg of the research. Due to the size of this group, mostly qualitative data, such as journal entries and detailed self-reported descriptions of students' experiences during group work, could be used.

The research questions that this study thus addressed are:

- What previous experience do IT students have of group work?
- Which roles do students take on, and how do they handle conflict, when implementing group work in various IT situations?

Results

“Let’s get this party started...”

Seven students reported that they liked working together in a group on a project or assignment, with only three being opposed to it. In motivating their answers, the proponents of group work liked the idea that the work load is shared, and they have company while doing the project. When they work in a group with other students, together they come up with many more different solutions to the problem than if one was on ones own. “Two heads are better than one!” Most of the time, they hear ideas that one would never have thought of. Anyone in the group can offer his or her opinion and understanding of the work.

The main objection of the students who don’t like working in a group pertains to freeloading, which results in a disproportionate distribution of work. They like doing their own work. In a group there are always people who want to take the lead and order everybody around, while do-

ing very little themselves. Although this does not always happen, the possibility of it happening is always there. Another believes that when he works in a group his true performance in the relevant learning area is not being evaluated, but rather his ability to cope with the inabilities and shortcomings of the other members of his group. He then ends up doubling his input towards the greater cause of the task at hand, thus actually compensating for the lack of interest and knowledge of others. One of these students does add that despite the views expressed, he does like working in smaller groups, where there is better control over the people in the group.

One student prefers to work alone rather than in a group. Another stated a preference for working individually, but if she has to be in a group, would like to have only one partner. The preferred group size of four more students was pairing, as this, for them, represents the ideal combination: even though the work load is less, most of the hassles associated with larger groups are avoided. Two students like working in groups with three to four members - both of them contrast the manageability of groups this size favorably with that of groups of five or more. The remaining two students indicated that their choice of group size would depend on the size of the assignment: they would rather do small projects on their own, pairing leads to less scheduling problems when trying to find time to work together, while groups of three to four, if everyone does their bit, offer the benefit of less work for each group member.

Some of the biggest advantages of group work mentioned by students include that work can be divided into smaller sections, so that each group member has less to do - this makes it is easier to overcome difficult problems. When each member in a group submits different ideas, all gain new knowledge from others. If someone doesn't understand a particular concept, the group can help, and specifically, "stronger" students helping "weaker" students.

Students' opinions on the biggest disadvantage of group work are fairly unanimous: Some members of the group (usually the most knowledgeable) do all the work, while other members of the group "sit back and enjoy the ride". Even though they don't co-operate by doing their share or what is expected of them, but instead depend on others to do all the work, in the end everyone in the group typically get the same mark for the group assignment.

All students, but one, agreed that group work can be applied meaningfully when learning Information Technology/ programming skills. This is because learning programming and completing assignments while doing so can be very hard if one is on ones own - in a group, students who understand the work better/faster can explain to and support other students, and different people also come up with different ways of approaching a problem, resulting in an improved end product. The student who did not think that group work can be applied meaningfully in this context feels that the only place where group work would function ("properly") is when discovery discussions are implemented, and he is of the opinion that IT bears little to no instances of this.

Good Intentions...

Students' first journal assignment was to complete a preview of what they would each bring to the group, in terms of positive and negative traits, which roles they saw themselves assuming within the group and the good intentions they were going to try and implement while working in the group.

Tarutu (these four students each chose their own pseudonym) planned to really work hard and help other group members where possible. She tends to do things her way, and might get upset if it does not happen this way. She also likes her work well structured, which could result in her assigning equal sections of the work to all group members. Although some group members might appreciate this, others could construe it as her "playing boss".

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According to Cay, students often embark on group work without even realizing it. In this first journal assignment, she was going to take a step back, look at the fundamentals of group work, and then generate her own list of resolutions for this semester’s group projects. If she was to set out some rules for the group to follow, they would be that all group members should be well prepared for group meetings, while each group member should take an active role in the group work by contributing ideas, responding to the input from other learners and sharing the work load. Each group member should also remain focused on the task at hand, work productively towards completing it and co-operate with the other group members. In order to have a successful group work experience, each individual needs to prepare thoughtfully and thoroughly. The members need to work together and this will bring about a better understanding of the subject matter. Some of the advantages to group work is that you can depend on both your own abilities, as well as those of the other group members. When facing a problem you get to look at it from different aspects as each member brings a new idea to the table.

Both Cay and Elma name various roles that one could take on within a group, such as motivator, peacemaker, leader, timekeeper, presenter, scribe, noise-controller and someone to make sure that the group stays on task. The role of the leader is to guide the group to achieve its goals in a productive and cooperative way. Then there is the role of the “sub-ordinates”. They offer ideas and actually do the work. The group leader is also a sub-ordinate. Another role player in group work is the peace maker. It is common to find that group members don’t always get along, and it is then that the peacemaker needs to step in. Another role mentioned is that of the scribe. It is his or her responsibility to take notes during discussions. The time keeper is another role - here the person has to keep track of time and keep an eye on the dead line and the amount of work still needs to be done. Someone in the group may also take on a “supportive” role. This person encourages the group and keeps the members positive.

Elma does not specifically indicate which of these group roles she sees herself as fulfilling. Cay frequently takes on more responsibility than she should - she should trust other group members to successfully complete the tasks they were assigned. She also often finds herself in the hat of the “encourager”, as she not only seems to keep positive longer than most people in the group, but also encourages and supports them a lot.

In contrast, Dawie definitely doesn’t see himself as acting as the “motivational speaker” - he can sometimes be very negative. He however hopes to make up for this by his good sense of humor. He’ll try to be involved in all the sessions and keep his work up to date - although this might take some doing, he feels that he owes as much to the people in his group.

Getting There...

All students started out well on their weekly journal entries by completing something on the group work done during the first week of implementation. However, later during the semester journal entries peter out as all sorts of work pressures mount.

During the first week, things started out slowly; too slowly according to some students, with it seemingly taking very long to come to a point. Tarutu acted as the scribe. Students also sub-divided into pairs: Cay and Elma worked in a group and it went well. Elma felt that Cay did her share, while Elma almost just sat there and confirmed everything Cay said. Cay, on the other hand, felt that she had let the group down by not knowing exactly what to do for a certain assignment. In future, she was going to write all instructions down. They feel that they are lucky to be in the group that they are, as no one has any problems working with each other. Cay also was a bit confused as to how exactly they were going to put all the different parts of the projects together without jeopardizing the work already done. She was looking forward to working this out, though. She would really like to understand the programming a bit better, and also needs to prove

to herself that she can actually do it. Although it was going to require a lot of extra work on her part, she was willing to do it. Maybe she would be able to help other members of her group, and she was really hoping that they would help her. She is also of the opinion that Tarutu lead the group on a specific occasion during the first week. Dawie mentions that tempers almost flared due to personal views playing a large role in the cooperation within the group.

Two weeks later, after a week containing a public holiday, Tarutu indicates that she enjoys the group work - once the group got started! She seems to be frustrated by a group member not paying attention to what is being done by the rest. Cay proclaims that group work is a lot of work. On the particular day described, Dawie was doing the typing and everyone was giving their two cents' worth. Cay got really irritated with the "typist" - he spent so much time fiddling and trying to be really clever that in the end they got nothing done. She eventually suggested that they all spend some time at home and figure out what they were going to use. Dawie "totally blew a fuse" when he heard that Cay had done some work on the code that he had already done. It almost felt like it's OK if he uses their work as a base to work from, but as soon as they used "his" work, he was not happy. She was however really pleased to see that he was actually contributing quite a bit to the group work. She felt that she was contributing the least at that moment, and that they were aiming too high with the code. Some of the alterations that they wanted to do were quite large tasks. They should rather have decided to spend more time on other smaller tasks. She felt bad for Tarutu - she had some really tricky code to do and none of them knew exactly how to help her sort it out.

After another week had flown by, Dawie reported that the group was unable to compromise or reach a decision on a certain issue. Everyone in the group had his/her own ideas about what they wanted to do and what it should look like. This indecision concerned him, as the work was slowly piling up. Differences between group members, as to the level of 'perfection' that work needs to be done to, were also causing fairly big problems.

Students do mention that the group work is running more smoothly as time passes. Tarutu felt at times that she was not contributing to the group, but once her part of the project worked, she would feel better.

When All Is Said and Done...

At the end of the semester students were required to submit a final summative commentary on their experiences while doing group work. They were provided with a set of guiding questions they could use to structure their responses, based on a questionnaire used by Miller (2003).

In terms of the group or social roles played by the different members of the group, Tarutu took notes when necessary, and provided motivation and support to some group members when they felt that everything was just becoming too much. Cay took on responsibility for the group as leader. She tended to handle assembly of final versions of various projects ("last minute rescuing"), as well as trying to make sure that the latest version of the work was always available so that everyone was working on the correct version. Observing group dynamics normally fell to Elma. According to the other students, she acted as the peacemaker, defusing tense moments with a calm word or quick joke. Elma was also the group's "MAJOR support system". She has a very quite type of personality, but was able to pick up all the pieces in her own quite way. A lot of the time no one really realized what she actually brought to the group. Without her Cay strongly believed that they would not have completed their work. Dawie saw himself as the troublemaker, as he was not interested in a lot of the work. This sentiment is echoed by Cay: Dawie would put his foot in it a lot and often said something that got someone else a bit angry. Frequently, he didn't even realize what had happened. His tendency to propose tasks or alternatives sometimes made members think about their decisions, but at times interfered with the smooth functioning of the

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group. On the positive side, Dawie was seen as a “technician”. He would assist other students when they had a problem with a program that they were working with, and even the actual operation of a certain program.

“The peacemaker” can’t think of any conflict worth mentioning - if there was any, she just ignored it. When it came to work, she just did her own thing and let the rest be. However, both Tarutu and Dawie agree that they definitely fought a lot, although they never had full-blown arguments. At times it was about the course that they were taking, but mostly it was over personal issues other than computers. They are a very close group as they have spent a lot of time together over the years (in the classroom and out). Although this made it difficult to explain the type of conflict issues they had, it made it very easy to explain how they solved these: They mostly talked about any conflict. Sometimes it was for a couple of hours, involving a really heated “discussion”. Other times they would talk about it in a joking way, it only took two minutes and then things would be sorted out. Cay thinks that they learnt a lot during these times.

None of the group members felt that another member joined the group for a free ride, although Tarutu does feel that at one stage she was working on a piece of programming that didn’t overlap with anyone else’s. Although there were times when each of them took a “free ride” during the semester, in most cases there was a valid reason, everyone understood and there wasn’t any serious problems as a result thereof. Students generally experienced that everyone had something to do, and all took responsibility for their work. Some students might have taken on more than their share, but nothing was done about this.

Discussion

In the advantages of group work mentioned by students in the initial questionnaire, students echo statements made by Nuutila et al. (2005). When group members analyze problems together from different perspectives, it not only helps them to understand difficult issues, but they also get support from their peers that helps in relieving some of the anxiety caused by these difficult topics. From their answers in the questionnaire, student teachers know these advantages. However, if in-service teachers are undergoing training, one would need to query them to establish whether they do; if not, they need to be made aware of this potential.

The fact that the group took so long to really get started could indicate that they had spent too long changing their minds about what to do, and as a result they might not have had enough time to complete projects as initially planned. Teachers/lecturers need to make sure that more of the time allocated for cooperative work are spent in discussion and planning, as a plan is important in order for everyone to know exactly what they will be doing. Groups usually benefit from using a piece of paper to write everything down. It is advisable to ensure that groups are able to give a short account of how they had planned their work, and that they keep a record of their decisions.

Dawie displayed many characteristics indicative of a group member who is not always a good group worker, similar to those mentioned by McAllister (1995): at times he appeared to be bored and was not interacting with his group. Sometimes his effort and interest was minimal in comparison to other group members. Now and then it was also difficult to get and then hold his attention. He might benefit from realizing that it is important for the good functioning of the group to be willing to listen to the other people in the group and find out what their ideas are. Dawie’s behavior reminds us that teachers should not only be trained in how to handle ‘trouble-makers’ in groups, but also how to teach their learners how to handle such group members themselves, and any accompanying conflict that might occur because of these ‘unruly’ learners’ behavior.

The group observed in the case study conformed with the elements of cooperative learning (see literature study):

- Group members were linked in that no-one individually succeed unless they all did,

- each group member was responsible for making their own personal contributions to group learning,
- reflection took place about how the group is functioning in the journals and final submissions on group work,
- group members used interpersonal and small-group skills to facilitate learning when helping each other as they worked on their tasks, including the assumption of a leadership role and effective communication, and
- constructive face-to-face interaction was exhibited.

It is not clear from students' reflections whether they purposefully adhered to these elements. However, the fact that they were able to handle conflict when it arose in the group, together with bringing in the required group products according to specifications, show that the presence of the cooperative elements did enable the group to work effectively. All teachers should obviously be well trained in ensuring that these elements are successfully implemented in their learners' groups.

One of the queries most often encountered with regard to group work (that teachers will need to be trained in it extensively) is the issue of assessing individuals' involvement when the product of the group work is a single project. Although this is not specifically mentioned in students' journals, it is intricately tied into the elements of positive interdependence and individual accountability mentioned in the previous paragraph. Teachers/lecturers need access to techniques that they can implement in order to obtain information for the assessment of individual students in group project situations (Hazzan, 2003). After each group work session McKinney and Denton (2005) required their students to assess each group member using a peer assessment instrument consisting of items specifying positive contributions for each group member, good contributions from different members towards the group effort, possible weak spots displayed, and an indication of the global contribution level for each group member. They were also asked whether they would you want a specific group member on their groups again. A final cumulative peer assessment instrument "explicitly asked each student to rate each group member on" (p.468) group skills such as communication and cooperation. It is important to be able to teach group members how to "avoid negative comments, and to present their critiques in a positive light" (Pollock & Jochen, 2001, p. 226). In the marking of the group projects that the students in the case study completed, we used the principle suggested by Pollock and Jochen (2001): All group members started with the same grade, but that grade was then altered for each member in accordance with their individual contributions as reflected in their peer assessments.

Importance of the Study

There is a significant body of literature available in CS/IT education, going back a number of years, discussing group work learning and dynamics in programming, software development and computer group projects in general. Some of the patterns reported by the paper are interesting in that they show results which are consistent with those observed in existing research findings for empirical studies, re-enforcing current thinking by reconstructing or validating what is already reported literature. Although the idea of using cooperative learning in IT education is therefore not new (Beck et al., 2005), the importance of group learning is ever increasing.

The authors' claim to originality in this contribution lies in the log of a large amount of descriptive detail of the interactions between this particular group of students, and in having student teachers think meta-cognitively about their behavior during group work. The collection and clear qualitative description and analysis of student teachers' views on their group work experiences in this study contribute as significant work. In this way, the study offers new results and insights that

would be of interest to other CS/IT lecturers and in-service IT teachers, and thus benefits the CSITEd research community.

Further potential of this work is situated in the contribution it makes towards the development of a model for the application of group work in the IT classroom, which can be used in the training of pre-service and in-service IT teachers. Although the population of this study consisted of undergraduate pre-service student teachers, an analytical discussion of their experiences provide a set of pointers of how this knowledge can readily be used in training both pre-service and in-service teachers. In this way, the ultimate outcome of the research program will make a significant contribution when results are ultimately relayed back to application in schools to support teachers with help for applying group work effectively in IT classrooms.

Conclusion

Students' responses regarding their implementation of group work across various knowledge domains within the IT curriculum show that they not only learnt the basic knowledge and skills regarding group work, but were also able to put these into practice successfully while working together in a group. They could work together well, assume various roles within the group and resolve conflict when it arose. Students understand the dynamics of group work and the contribution that group work could make to effective learning and teaching in the IT class. Having lived through practically what they learnt about group work should go a long way towards ensuring that they will be able to apply the knowledge and skills gained in their own IT classrooms.

With regard to possible limitations of this study, some might feel that the empirical evidence is limited in terms of the introspective technique used. The number of participants in this study did not provide a population large enough to yield results that can necessarily be extended and/or generalized to other student populations. The authors hope to pursue a larger-scale study along these same lines that, if well designed and carefully analyzed, can provide an even more valuable research contribution to studies of cooperation in Information Technology education.

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