

EDUCATION FOR DEMOCRATIC CITIZENSHIP: THEORY AND TEACHING PRACTICE

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Collaboration in Informatics Lessons

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The broadest definition of 'collaborative learning' is that it is a situation in which two or more people learn or attempt to learn something together, meaning

- "two or more" may be a pair, a small group (3-5 subjects), a class (20-30 subjects), a community (a few hundreds or thousands of people), even a society.
- "learn something" may be learn course material, perform learning activities such as problem solving, work on a project, etc
- "together" may include different forms of interaction: face-to-face or computer mediated, synchronous or not, at regular intervals, by dividing labour, by following specific roles, etc.

Collaborative learning has been shown to correlate with greater learning, increased productivity, more time on task, transfer of knowledge to related tasks, and higher motivation. Collaborative learning may foster

- Development of critical thinking
- Responsibility for learning
- Clarification of ideas
- Evaluation of others ideas

There are five fundamental elements involved in cooperative learning.

Positive Interdependence

This means the group has a clear task or goal so everyone knows they sink or swim together. The efforts of each person benefit not only the individual, but also everyone else in the group. The key to positive interdependence is committing to personal success as well as the success of every member of the group. Group members realize, therefore, that each person's efforts benefit not only him- or herself, but all other group members as well. Positive interdependence creates a commitment to other people's success as well as one's own and is the heart of cooperative learning. If there is no positive interdependence, there is no cooperation.

Proposed ways to ensure positive interdependence:

- The resources are for all.
- A task is divided into subtasks and can't be finished unless all contribute.
- Each person may focus on a specific task/subtask and learn a specific topic, but s/he has the duty to "teach" the whole group for what s/he learned ((Jigsaw method).
- A reward (e.g. bonus points) may be offered if the group succeeds and each member succeeds.



Individual and Group Accountability

The group is accountable for achieving its goals, and each member must be accountable for contributing a fair share of the work toward the group goal. No one can "hitchhike" on the work of others. The performance of each individual must be assessed and the results given back to the group. The group has to be clear about its goals and be able to measure (a) its progress in achieving them and (b) the individual efforts of each of its members. Individual accountability exists when the performance of each individual student is assessed and the results are given back to the group and the individual in order to ascertain who needs more assistance, support, and encouragement in completing the assignment. The purpose of cooperative learning groups is to make each member a stronger individual in his or her right. Students learn together so that they can subsequently perform higher as individuals.

Proposed ways to ensure individual and group accountability:

- Students work on their own, prepare the assigned task and bring their work to the group.
- One student is chosen at random and questioned on the material the group has studied and worked on.
- All members of the group have to present orally their work.

Interpersonal and Small Group Skills

Interpersonal and small group skills are required to function as part of a group. These are basic teamwork skills. Group members must know how to - and be motivated to - provide effective leadership, make decisions, build trust, communicate, and manage conflict. Teachers have to teach teamwork skills.

Proposed ways to ensure interpersonal and small group skills:

- Form a collaboration contract.
- Encourage students to be on time in case of group meeting, either face-to-face or online.
- Make sure everyone has the opportunity to speak.
- Listen to others and impel students to do so. Ask students to comment on their fellows' opinion.
- Urge students to express their opinion and participate in decision making processes.
- In case of conflict, try to control it, provide alternatives, ask all members to express their beliefs and guide them to resolve the problem.

Face-to-Face Promotive Interaction

This means that students promote each other's success by sharing resources. They help, support, encourage, and praise each other's efforts to learn. Both academic and personal support are part of this mutual goal. Cooperative learning groups are both an academic support system (every student has someone who is committed to helping him or her learn) and a personal support system (every student has someone who is committed to him or her as a person).

Proposed ways to ensure face-to-face promotive interaction:

- Each member explains his/her solution to a problem.
- One group member discusses a concept with others.
- A group member teaches classmates about a topic.
- Students collaborate in pairs following approaches such as pair programming.



Group Processing

Group members need to feel free to communicate openly with each other to express concerns as well as to celebrate accomplishments. They should discuss how well they are achieving their goals and maintaining effective working relationships. Groups need to describe what member actions are helpful and unhelpful and make decisions about what behaviors to continue or change. Continuous improvement of the process of learning results from the careful analysis of how members are working together.

Proposed ways to ensure group processing:

- Group members describe each other's helpful and unhelpful behaviors and actions.
- As a group, make decisions about which behaviors to continue and which behaviors to change.

We cannot expect learning gains just because learners are sitting together or connected by a wire or because the teachers ask them to collaborate. The 'collaborative' situation is a kind of social contract, either between the peers or between the peers and the teacher (then it is a didactic contract). This contract specifies conditions under which some types of interactions may occur, there is no guarantee they will occur. A general concern is to develop ways to increase the probability that some types of interaction occur.

Forming groups

The most frequent questions that teachers ask are: What is the optimal group size? Should I select group members with respect to some criteria or leave them making group by themselves? Boys and girls together? Is it better to have group members who have the same viewpoint or not, the same general level of development or not, the same amount of knowledge with respect to the task at hand or not? Which group formation would enable each student to get actively involved?

The smallest group is two (2). The largest recommended group is 6-7. Smaller groups will require fewer social skills and will work more quickly, while larger groups generally generate more ideas, deal better with complex ideas

Group formation should be considered when deciding on how best to meet and achieve the learning goals.

A variety of group formation techniques have been used. in forming learning groups such as random assignment, learner-formed groups or grouping according to academic (e.g. knowledge of a subject), social (e.g. gender), traits (e.g. learning style). Also, the choice of homogenous or heterogeneous groups is a question. Several factors may affect the relative merit such as students' abilities, traits, curriculum area, and task. If the project is long or detailed then the support of a stronger academic student in each group will help complete the project.

Social dynamics plays a strong role. When a female student is isolated (an all too common occurrence in computer science classes), she may quit and not participate at all. Also, some students are naturally more vocal, while others are more quiet. In a group with quiet people,

a vocal person will either dominate or be uncomfortable due to the lack of active, vocal interaction within the group. Similarly, a quiet person might not interact at all with a group of vocal people.

Random assignments help mix up the class but do not directly address the problems caused by social dynamics. Student-formed groups almost guarantee that a person will be comfortable with their group, but such groups are often based on friendships and thus do not promote socialization within the classroom community or do not promote achievement of learning outcomes. Random is best used if the task is of short duration.

In programming courses, where the formation of groups was based on comparing the programs produced by students, the learning gains were significantly higher than those following a random assignment or learner-formed groups.

Collaboration scenarios and roles

An approach to promote collaboration is to specify a specific collaboration scenario where students may be assigned specific roles or follow a specific collaboration script.

Group roles is a strategy that helps students take individual responsibility for a shared group goal. By designating roles within the collaborative groups, the teacher can help ensure that all team members take ownership of the group's work. The roles that the teacher or the students assign depend on the goals of the assignment, the size of the team, etc.

Possible student roles within the group are:

- Facilitator: keeps group on task and verifies that all contribute.
- Recorder: takes notes on important thoughts expressed in the group. Writes final summary.
- Reporter shares summary of group with large group and speaks for the group.
- Materials Manager: picks up, distributes, collects, turns in, or puts away materials.
- Checker: checks for accuracy and clarity of thinking during discussions. Checks written work and tracks points.

Assigning group roles can be a beneficial strategy for successful group work design for a number of reasons:

- Group roles offer an opportunity for high quality, focused interactions between group participants. Participants are more likely to stay on task and pay closer attention to the task at hand when their roles in the collaboration are clear and distinct.
- Group roles provide all students with a clear avenue for participation. Students are less likely to feel left out or unengaged when they have a particular duty that they are responsible for completing. Along the same lines, assigning group roles reduces the likelihood of one individual completing the task for the whole group, or "taking over," to the detriment of others' learning.
- Group roles encourage individual accountability. Group members are more likely to hold each other accountable for not completing work if a particular task is assigned to them.
- Group roles allow students to strengthen their communicative skills, especially in areas that they are less confident in volunteering for.

- Group roles can help disrupt stereotypical and gendered role assignments, which can be common in group learning. For example, Hirshfield and Chachra (2015) found that in first-year engineering courses, female students tended to undertake less technical roles and more communicative roles than their male colleagues.

Another way to scaffold productive interactions is by encompassing interaction rules. The teacher may specify interaction rules for face to face collaboration, such as "Everybody in the group should give his or her opinion". In CSCL, interaction rules can be continuously reinforced.

Also, discussion guidelines may be given which concern the way students exchange messages. Sentence starters may facilitate safe and productive discussion. Examples of sentence openers are:

Agreement

- "I agree with ___ because ___."
- "I like what ___ said because ___."
- "I agree with ___ because ___; then on the other hand ___."

Disagreement

- "I disagree with ___ because ___."
- "I'm not sure I agree with that because ___."
- "I can see that ___; however, I disagree with (or can't see) ___."

Clarifications

- "Could you please repeat that for me?"
- Paraphrase what you heard and ask, "Could you explain a bit more, please?"
- "I'm not sure I understood you when you said ____. Could you say more about that?"
- "Is there evidence for the position?"
- "How does that support our work/mission at ___?"

Confirmation

- "I hear ___."
- "I believe ___."
- "I discovered ___."
- "I learned that ___."

Confusion

- "I don't understand ___."
- "I am confused about ___."
- "Can you explain that another way?"
- "I have a question about ___."

Extension

- "I was thinking about what ___ said, and I was wondering what if ___."
- "This makes me think ___."
- "I want to know more about ___."
- "Now I am wondering ___."
- "Can you tell me more about ___."



Review

"I want to go back to what _____ said."

"I like _____."

"I noticed that _____."

Pair programming

Collaboration has emerged as a central component of many computationally intense jobs and is now a component of many computer science curricula. Pair programming offers a structured form of collaboration for computer science learning that has been successfully used in a wide variety of K-12 and postsecondary computer science courses.

In pair-programming, two programmers jointly produce one artifact (design, algorithm, code, etc.). The two programmers are like a coherent, intelligent organism working with one mind, responsible for every aspect of this artifact. One partner is the "driver" and has control of the pencil/mouse/keyboard and is writing the design or code. The other person, the "observer" (or "navigator"), continuously and actively observes the work of the driver - watching for defects, thinking of alternatives, looking up resources. The roles of driver and observer are deliberately switched between the pair periodically. Both are equal, active participants in the process at all times and wholly share the ownership of the work products.

Pair programming has been successfully implemented in many computer science courses, and research shows benefits to learners. Students have reported that pair programming gives them a glimpse into the collaboration that happens in the real world and how the perspective of a partner can help broaden one's own knowledge. Pair programming also gives students a greater sense of responsibility.

Some studies, however, reveal that students can have negative attitudes towards pair programming. Although students may praise pair programming for enabling discussion and planning, some students found it to be time consuming, particularly if partners' opinions differ and tasks are not distributed evenly.

Teachers should encourage highly interactive, substantive dialogue from both students during pair programming. Drivers should be encouraged to think aloud, and observers should be encouraged to actively provide feedback. Observers should know that it is normal for them to talk more than drivers, and that giving feedback is helpful. Teachers may provide students with assignment sheets where they will record the main points and the evolution of their work. The assignment sheet may include questions that may guide each student to serve his/her role. In case of face-to-face classrooms, the teacher may consider stopping by pairs who are silent, asking the observer to summarize their most recent achievement, or the driver to articulate their current goal. These self-explanations may be very beneficial to students. Because of the importance of common ground among the two collaborators, when one student feels uncertain, both partners must recognize that an expression of uncertainty is constructive. However, if a large proportion of dialogue focuses on uncertainty, the pair may need outside help.



Buddy programming

Pair programming is great, but students also appreciate autonomy. Still, individual work doesn't mean the collaboration has to end!

Buddy programming allows students to work on their own program, but also have a buddy to consult if they have a question. Buddy programming is ideal for longer labs and projects where students are expected to demonstrate their own understanding of a concept.

Buddy programming is less social than pair programming, so buddies may need prompting to connect. The teacher may urge students to ask their buddy if they have a question. When buddies are asked questions, they are expected to respond and help their buddy to the best of their ability. Since a relationship between buddies takes longer to grow than a pair programming relationship, where partners talk constantly, the teacher should consider switching up buddies less frequently so students have time to become comfortable with their buddy.

Mob programming

Mob programming can be an opportunity for students to share knowledge at a large scale as they watch each other problem-solve. The entire class can work together to solve a programming problem.

In its most basic form, mob programming requires one driver, and everyone else serves as a navigator. The teacher should

- consider problems that the majority of the class can solve so that avoid some students dominate the process.
- establish a protocol that requires everyone to talk in an orderly fashion. You can go around the room and have each person say the next line of code to write.
- help dominant students self-regulate. For example the teacher can give them three cards each, and have them give one card to you each time they contribute. After all their cards are gone, they cannot contribute.
- grade students on their quality and inclusivity of their problem-solving. In a subject like computer science, students would work together to solve coding problems – and they would not be able to earn full credit unless they solved the problem *and* everyone participated in a supportive atmosphere.

Educating through art

In recent years the use of art for educating purposes has been developing in both formal and informal education. Research points out that education and training through art pieces can positively contribute to the learning process and help students develop competences such as critical thinking, creativity, emotional expression. The research data shows that art offers the opportunity to be and in this case to study in different places, to think in different ways and to interact with different things.

Transformative learning theory, which is rooted in adult learning theory, states that adults could experience transformative learning by reflecting and revising structured assumptions based on personal experiences, thereby gaining a newfound perspective (Mezirow, 1991, 2000). The theory encourages learners to critically reflect on their assumptions and preconceptions in order to transform their existing frameworks and perspectives. Mezirow (2000) asserts that learning involves the process of using prior knowledge to understand and construct a new and revised interpretation of the meaning of one's knowledge, as well as



the experience to move forward to future action. Seeing through art enables people to interpret everyday life experiences and objects in different ways while “transforming one’s consciousness”. There is a strong argument that the arts have the power to transform individual worldviews, and when experienced collectively can potentially transform whole communities

By observing a work of art, one can evaluate critically the validity of her/his own perceptions or beliefs and therefore s/he can question the reliability of assumptions that considered as granted. One needs to observe art works that are unconventional, universal, authentic, symbolic, alternative, expressing messages about human values and characterized by aesthetic harmony.

Perkins suggests four phases for the systematic observation of artworks.

1st phase: the facilitator asks learners to take looking time in order to catch the spirit of the artwork. He encourages them to let questions emerge and ask themselves about interesting features or discover new ones.

2nd phase: learners are stimulated to search for characteristics of the artwork that make their observation broader, to notice sides that otherwise remain invisible.

3rd phase: the facilitator asks the participants to investigate more analytically the artwork by exploring deeper what surprised, interested, or puzzled them. They might also compare the artwork with another one that seems to be related in some way.

4th phase: the learners review the work holistically, marshalling all they have discovered.

Kokkos defined a method that attempts to promote transformative learning through aesthetic experience. The method consists of six stages and uses Perkins’s approach on the systematic observation of artworks.

1st stage: Determination of the need to critically examine a habit of mind.

It contains the determination of the need to critically examine the taken for granted assumptions concerning a major issue (habit of mind).

2nd stage: The participants express their ideas about the points of view that need to be examined

The teacher may ask students to write down their opinion and their thoughts on a specific matter. The students may collaborate in small groups or may work alone.

3rd stage: Identification of the points of view and the aspects of the first one

At this stage the educator examines the participants’ suggestions and discusses with them the points of view that should be holistically and critically approached in order to re-assess the taken for granted assumptions. A number of critical questions are defined. The group discusses the order of the examination of the points of view as well as identifies the aspects of the first one that should be examined.

4th stage: Identification of artworks

During this stage of the method, the educator identifies several artworks which could serve as stimuli for the elaboration of the various aspects of the point of view at hand (the meanings of the artworks have to be related to the aspects). In another version of the stage

the participants may suggest various artworks which may be incorporated in the learning process. The teacher may formulate an array which interrelates the chosen artworks with the critical questions.

Artworks	Critical questions			
	CQ1	CQ2	CQ3
Artwork1	√		√	
Artwork2	√	√	√	
...				

The teacher should choose artworks that are closely related to the critical questions, stimulate critical thinking on the issues examined, motivate students to compare them with their experiences and, of course, have aesthetic value.

5th stage: Critical elaboration of the aspects through aesthetic experience

During this stage, the educator facilitates a process which aims to approach the various aspects at hand from different perspectives in order to reveal to the participants as many different cognitive, affective and imaginative dimensions of learning as possible and to offer them the opportunity to revisit their initial views. One of the main learning tools in this process is the aesthetic experience. The observation of every artwork is implemented using Perkins’s methodological tool.

6th stage: Critical Reflection on the Experience

At this stage, the educator facilitates a critical evaluation of the previous steps, for example a discussion aiming at the comparison of the participants’ initial assumptions about the point of view with those resulting from the previous stages. The group may also discuss the impact of the aesthetic experience in the whole process.

ICT offers possibilities that enable the digital rendering of works of art such as high resolution photographs, digital representations, panoramic tours of museums and galleries, as well as access to collections of works of art, etc. In recent years, museums and galleries have participated in cultural collaboration networks giving the public the opportunity not only to see the works of art but also to engage in activities that allow their critical analysis.

Available resources

Google Arts and Culture <https://artsandculture.google.com/>

New-York Historical Society <https://www.nyhistory.org/>

The National Gallery <https://www.nationalgallery.org.uk/paintings/henri-rousseau-surprised>

References

Mezirow, J. (2000). *Learning as transformation: Critical perspectives on a theory in progress*. San Francisco: Jossey-Bass.

Without the cooperation of its members society cannot survive, and the society of man has survived because the cooperativeness of its members made survival possible.... It was not an advantageous individual here and there who did so, but the group. In human societies the individuals who are most likely to survive are those who are best enabled to do so by their group.

(Ashley Montagu, 1965)

