Significance of discussion facilities in collaborative problem solving

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Purpose of study
To find out how students interact with the facilities and fellow students in discussion rooms, their perceptions about the impact of the facilities on their learning in particular the development and application of collaborative problem solving (CPS) skills
Background

• Global development in 21st century creates many challenges and issues

• New tasks are open-ended, involve unbounded sets of information, and require ongoing re-definition of their goal

• Renewal of education for a world society where human being need to learn living together under increasing competition and tension (UNESCO, 1996)

• Collaborative problem solving (CPS) becomes a critical skill set
Evolvement of learning spaces

• Advancement in pedagogy and technology has enabled learning outside the classrooms, e.g. mobile learning and ubiquitous learning (Dumont & Istance, 2010; Shih, Chu, Hwang, & Kinshuk, 2011)

• Recognition of informal learning through re-thinking the design of non-classroom spaces (Jamieson, 2009, 2013)

• Research interest has shifted from formal learning spaces to those for informal and social learning (Boys, 2011)

• Many informal learning spaces have now incorporated open or closed spaces for group work
## Group work vs collaborative problem solving

<table>
<thead>
<tr>
<th>Group work (Douglas, 1976)</th>
<th>Collaborative problem solving (Griffin &amp; Care, 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members cooperate to enhance the total output of an activity</td>
<td>All members contribute their own resources to the process and rely on each other to put forward information and resources for the common goal</td>
</tr>
<tr>
<td>Aims to cater for individual differences or to generate conforming standards of behavior and judgement</td>
<td>Aims to reach collective consent on the process and the solution</td>
</tr>
<tr>
<td>Task assessment focuses on the total output</td>
<td>Task assessment focuses on both the process and solution / outcome</td>
</tr>
</tbody>
</table>
Assessment of group learning spaces

• Approaching learning as both an intellectual process and a collaborative activity

• Using a set of empirically validated developmental progressions of cognitive skills and social skills for CPS established by the Assessment and Teaching of Twenty-First Century Skills Project (ATC21S) (Griffin, Care, & McGaw, 2012)
  • Measurable
  • Theoretically derived
  • Validated through large scale assessment data in Australia, Finland, Portugal, Singapore and the United Kingdom (e.g. PISA 2015)
Theoretical frameworks referenced by the ATC21S assessment approach for CPS

• Zone of proximal development (Vygotsky, 1980)
• Criterion-referenced interpretation (Caser, Chudowsky & Pellgrino, 2001)
• Probabilistic model for interpretation and empirical validation of competence levels by using latent trait theory and mathematical modelling (Rasch, 1980)
Methodology

Creation of an observation checklist and an interview protocol for the subject groups using the above set of tool (Griffin, Care, & McGaw, 2012) to analyze the activities observed in group learning spaces and students’ comments on the impact of group learning facilities on CPS.

<table>
<thead>
<tr>
<th>Cognitive skills</th>
<th>Social skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Task regulation</td>
<td>• Participation</td>
</tr>
<tr>
<td>• Learning and knowledge building</td>
<td>• Perspective taking</td>
</tr>
<tr>
<td></td>
<td>• Social regulation</td>
</tr>
</tbody>
</table>

Each skill is subdivided into elements with specific indicators.
Research site
A comprehensive research university in Hong Kong with 25% of UG students and 50% of PG students from Mainland China and other countries

Subjects
13 groups of students mostly UG from various disciplines were invited for participation on voluntary basis

Qualitative research
442 mins of observations for group discussion (n=9) + 276 mins of semi-structured interviews (n=10)
Observations with video recording in discussion facilities

- Rooms with ordinary to good sound proof mainly in two learning commons
- One table and up to 12 chairs / room
- A projection system connectible with users’ own laptops or the computers provided on site
- Some of the rooms are equipped with electronic and/or manual whiteboards
<table>
<thead>
<tr>
<th>Group</th>
<th>Major purposes of visit and/or activities carried out</th>
<th>Facilities and mobile devices used</th>
<th>Averaged duration per visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 (SocSc &amp; Archi)</td>
<td>Group projects, class assignments</td>
<td>Laptops, smartphone, WiFi, projection system</td>
<td>2 – 6 hours</td>
</tr>
<tr>
<td>G2 (Med)</td>
<td>Class assignments</td>
<td>Laptops, WiFi, projection system</td>
<td>1 – 2 hours</td>
</tr>
<tr>
<td>G3 (Misc)</td>
<td>Extracurricular activities</td>
<td>Whiteboard, computer, WiFi</td>
<td>N/A</td>
</tr>
<tr>
<td>G4 (Arts)</td>
<td>Class presentations</td>
<td>Laptops, WiFi, power sockets</td>
<td>N/A</td>
</tr>
<tr>
<td>G5 (Archi)</td>
<td>Class assignments, group projects, preparation for competition or interviews</td>
<td>Video recorder, whiteboard, laptop, WiFi, projection system, power sockets</td>
<td>Depending on needs</td>
</tr>
<tr>
<td>G6 (Sc, Bus&amp;Econ)</td>
<td>Class and examination revision, group projects, class assignments, extracurricular activities</td>
<td>Laptops, WiFi, power sockets, projection system, whiteboard</td>
<td>2 – 10 hours depending on needs</td>
</tr>
<tr>
<td>G7 (Sc)</td>
<td>Class assignments</td>
<td>Laptops, smartphone, WiFi</td>
<td>N/A</td>
</tr>
<tr>
<td>G8 (Eng)</td>
<td>Group projects, class presentations, extracurricular activities, private study</td>
<td>Laptops, iPad, smartphone, WiFi, projection system, whiteboard, e-whiteboard, power sockets</td>
<td>1 – 2 hours</td>
</tr>
<tr>
<td>G9 (Sc &amp; SocSc)</td>
<td>Group projects, class assignments, extracurricular activities, hangout with peers</td>
<td>Laptops, smartphone, WiFi, whiteboard, projection system, power sockets</td>
<td>1 – 2 hours</td>
</tr>
<tr>
<td>G10 (Law)</td>
<td>Class assignments, extracurricular activities</td>
<td>Laptops, WiFi, whiteboard, power sockets</td>
<td>2 hours</td>
</tr>
<tr>
<td>G11 (Edu)</td>
<td>Group projects, class presentations</td>
<td>Laptop, iPad, WiFi, projection system, whiteboard, power sockets</td>
<td>4 hours or more</td>
</tr>
<tr>
<td>G12 (Law)</td>
<td>Group project, group revision</td>
<td>Laptops, WiFi, whiteboard, e-whiteboard, projection system, power sockets</td>
<td>1 – 2 hours</td>
</tr>
<tr>
<td>G13 (Med)</td>
<td>Class presentations, discussion of class materials</td>
<td>Laptops, WiFi</td>
<td>1 – 2 hours</td>
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<td>2 hours</td>
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<tr>
<td>G11 (Edu)</td>
<td>Group projects, class presentations</td>
<td>Laptop, Pad, WiFi, projection system, whiteboard, power sockets</td>
<td>4 hours or more</td>
</tr>
<tr>
<td>G12 (Law)</td>
<td>Group project, group revision</td>
<td>Laptops, WiFi, whiteboard, e-whiteboard, projection system, power sockets</td>
<td>1 – 2 hours</td>
</tr>
<tr>
<td>G13 (Med)</td>
<td>Class presentations, discussion of class materials</td>
<td>Laptops, WiFi</td>
<td>1 – 2 hours</td>
</tr>
</tbody>
</table>
Findings from group interviews

• A majority of the students expressed the basic needs of an isolated space with efficient network connection and power supply.

• The formal setting, reservation requirement and acoustics of discussion rooms in LC favourable qualities that helped to engage users in terms of punctuality, commitment and concentration.
<table>
<thead>
<tr>
<th>Time</th>
<th>Skill in CPS</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>05:10</td>
<td>Organises, set goals, action</td>
<td>Discussed project requirements and consented on goals. Schedule meeting with teacher by email.</td>
</tr>
<tr>
<td>05:20</td>
<td>Collects elements of information</td>
<td>Shared laptop screens to verify information/data/interesting ideas.</td>
</tr>
<tr>
<td>06:00</td>
<td>Collects elements of information</td>
<td>Checked overseas major geo hotels’ websites.</td>
</tr>
<tr>
<td>08:50</td>
<td>Collects elements of information</td>
<td>Double checked information retrieved on different websites.</td>
</tr>
<tr>
<td>09:20</td>
<td>Self evaluation, interaction, adaptive responsiveness</td>
<td>Drafted and revised an email to course instructor. Conducted cheerful discussion and showed harmonious rapport.</td>
</tr>
<tr>
<td>14:00</td>
<td>Action</td>
<td>Sent email to course instructor and opened Google Doc to create project document(s).</td>
</tr>
<tr>
<td>14:30</td>
<td>Self evaluation</td>
<td>Checked calculations for length of project report.</td>
</tr>
<tr>
<td>15:00</td>
<td>Responsibility initiative</td>
<td>S8 shared experience of past projects.</td>
</tr>
<tr>
<td>15:40</td>
<td>Resource management</td>
<td>Shared workload of project paper between members.</td>
</tr>
<tr>
<td>16:10</td>
<td>Systematicity</td>
<td>Verified teacher’s requirements of project including human impact as well as site visit details.</td>
</tr>
<tr>
<td>16:32</td>
<td>Transactive memory, relationships</td>
<td>S8 asked how to relate discussion and evaluation to members’ ideas for the project.</td>
</tr>
<tr>
<td>17:14</td>
<td>Self evaluation, interaction</td>
<td>Members made suggestions and comments on S8’s ideas.</td>
</tr>
<tr>
<td>23:05</td>
<td>Systematicity, resource management</td>
<td>Brainstormed ideas for discussion, evaluation methods and perspectives. S8 recorded data on library PC.</td>
</tr>
</tbody>
</table>
Commonly recognised contributing factors

“I feel that we will be more focused without other distraction... Because in a confined space, you will be realized by others if you play idle.” (G5)

“...it’s like when we meet we need an atmosphere to be like official or formal. The same like for study, if you study outside like Delifrance (food outlet) you can be like no mood. It’s very casual.” (G6)

“But when we book the room, everyone’s on time, because there’s a time limit. But when it’s outside, without a time limit, people don’t mind being late, but the time limits here are better... It makes us more concise and more efficient with time.” (G13)
## Application of social skills for CPS

<table>
<thead>
<tr>
<th>Element</th>
<th>Indicator</th>
<th>G1</th>
<th>G2</th>
<th>G5</th>
<th>G6</th>
<th>G10</th>
<th>G11</th>
<th>G12</th>
<th>G13</th>
<th>G14</th>
<th>G15</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>Activity within environment</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td>Interacting with, prompting and responding to the contributions of others</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Task completion</td>
<td>Undertaking and completing a task or part of a task individually</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
# Application of cognitive skills for CPS

<table>
<thead>
<tr>
<th>Element</th>
<th>Indicator</th>
<th>G1</th>
<th>G2</th>
<th>G5</th>
<th>G6</th>
<th>G10</th>
<th>G11</th>
<th>G12</th>
<th>G13</th>
<th>G14</th>
<th>G15</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task regulation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organises (problem analysis)</td>
<td>Analyses and describes a problem in familiar language</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Sets goals</td>
<td>Sets a clear goal for a task</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Resource management</td>
<td>Manages resources or people to complete a task</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Flexibility and ambiguity</td>
<td>Accepts ambiguous situations</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Collects elements of</td>
<td>Explores and understands elements of the task</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Systematicity</td>
<td>Implements possible solutions to a problem and monitors progress</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
Association between facilities in discussion rooms and CPS skill development/application

• Mostly mentioned social skills - “interaction” (10), “action” (7), “task completion/perseverance” (7) and “negotiation” (6)

• Social skills mentioned by half of the groups (5) – “audience awareness”

• Mostly mentioned cognitive skills – “set goals” (6), “resource management” (6)

• Cognitive skills mentioned by half of the groups (5) – “organises (problem analysis)”, “collects elements of information” and “relationships (represents and formulates)”,
Value of whiteboards

• Whiteboards were often mentioned by interviewees with positive comments associated with CPS skills:

Organises - “The whiteboard can help to list out the points of discussion systematically. And also some examples can be clearly shown under each point.” (G10)

Collects elements of information and resource management - “First of all, I will use the whiteboard to breakdown the elements of information by writing it down and showing it to everybody. Then if I need to gather information, I will go to Google… Usually, we will distribute the works by separating the elements and then assign tasks to different members.” (G5)

Relationships - “…because with the whiteboard you can use mind maps and list everything out clearly. It also relates to “identifies connections and patterns between and among elements of knowledge.” (G12)
Use of whiteboards (manual vs electronic)

• Students with technology background such as Group 8 (Engineering) tend to find the e-whiteboards useful. However, other students were not enthusiastic in using it.

“Don’t know how to use it. That’s the reason...There is no need to use such a high level [equipment]...Google Doc can also fulfil similar purposes.” (G1)

“[I will usually] take a photo [of the contents on whiteboard] with mobile phone, WhatsApp and then go.” (G2)

“I never use electronic ones. I use just white... you just need some time and stuff. But when you want to write something quick...convenience, quick access I would say.” (G6)
## Major findings

Contributing factors of discussion rooms to collaborative problem solving

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Behavioral</th>
<th>CPS skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Acoustics</td>
<td>• Concentration &amp; engagement</td>
<td>• Social skills (e.g. interaction, action, task completion/ perseverance)</td>
</tr>
<tr>
<td>• Formal setting</td>
<td>• Readiness for participation &amp; efficiency</td>
<td>• Cognitive skills (e.g. resource management, organises, relationships)</td>
</tr>
<tr>
<td>• Technology (e.g. ICT, booking system)</td>
<td>• Affordance: The properties of the environment that yield users support and opportunities of using them (Gibson, 1986)</td>
<td></td>
</tr>
<tr>
<td>• Visual display aids</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

• Based on user perceptions, space that was controlled and organized in terms of its availability, physical environment and functionality would increase their affordances.

• Similar finding was reported by Quinnell (2015) about students’ tendency to complete difficult assignments and subjects in spaces where affordances were obvious and users had control over the environment.

• Significance of a whiteboard in group work and CPS could be far beyond its financial value among other facilities.

Technology can enhance learning as long as it is provided with affordance in mind.
References


References


