Designing for learning in The Cube

A Guide

This guide[1] is to help academics at QUT incorporate The Cube in their curricula. It includes some general information about using The Cube in teaching, hints from those who have already used it and some insights gained from research.

[1] Developed by Ian Stoodley and Briony Wainman, with guidance from Simon Harrison, as part of a research project *Designing for learning in The Cube,* conducted 2018-2020 at QUT. A project report is also available on QUT Eprints.

General information

General information about using The Cube in teaching is organised here under:

- What can be included on The Cube?
- Who do I contact to talk about my idea?
- How do I arrange Cube display time?
- What constraints are there?
- Is there any help available?
- What advantages of including a Cube activity have others found?

What can be included on The Cube?

You may present material for a single class (e.g., student posters), through to a public display (e.g., an experimental environment). However, the more public your presentation is, the greater the amount of preparation needed.

Also, content that is already displayed may be useful to you. Existing content is listed on the QUT website (https://www.thecube.qut.edu.au/whats-on).

Who do I contact to talk about my idea?

The contact person is Simon Harrison simon.harrison@qut.edu.au

How do I arrange Cube display time?

Follow this link:
https://qutvirtual4.qut.edu.au/group/staff/engagement/events/booking-a-space-or-venue/qut-precincts-managed-spaces
See the instructions under *Self-Managed Venues - function and engagement spaces*
See *The Cube specific information page*, where there are content guides and a request form.

What constraints are there?

Your Cube-based activity may need to fit in with other events in The Cube space.
If your presentation is for public display, the general public must be able to understand it and find it interesting, at least at first encounter.

Is there any help available?

The Cube development team can help, depending on their other commitments.
See *Content development and templates for events* for templates, with formatting instructions:
https://qutvirtual4.qut.edu.au/group/staff/engagement/events/booking-a-space-or-venue/qut-precincts-managed-spaces/the-cube

What advantages of including a Cube activity have others found?

- The Cube is a stimulating space, so students are generally excited to participate in activities there.
- The large size of the Cube display makes visualisations life-like and easily viewed.
- The Cube format engenders group work, with small groups able to collaborate on a common project and students able to see each other's work.
- Clever design encourages learning through experimentation and provides a safe place for students to take (virtual) risks.
- It can accommodate individuals' diverse learning preferences.
- An activity may integrate experiences in other spaces, for example the Queensland Museum, engendering linked activities and connections with the wider world.

Comments

There are some constraints in using The Cube, organised here by:

- It's not a silver bullet
- The pragmatics of Cube time
- Support available
- Development timeline

It's not a silver bullet

While a Cube experience in the curriculum may provide an interesting diversion and attraction to students, it will not meet all the teaching needs in a unit. It needs to be seen as an instructional element, amongst others. The interaction with The Cube needs to be planned so it aligns with the unit's objectives. Careful timing of the interaction in the semester and within a longer class session will help maximise its effectiveness. For example, a unit on chemistry may lead the students to propose specific chemical interactions, which may then be tested in The Cube when firing rockets, and then written into an assessed report.

Some consideration needs to be made to what The Cube adds to existing classroom and personal technologies. The size of the display is one advantage, which assists visualisation and engenders group work. On the other hand, The Cube display is not necessarily high definition so not appropriate to present fine detail.

The pragmatics of Cube time

The location of The Cube creates a challenge for students whose home campus is elsewhere. Travel time from and to adjacently timetabled classes may be much greater than usual. Disruption to the participants' days may be significant. The additional demands on both the teaching staff and the students need to be justified.

In addition, given other demands on The Cube, the class may need to be scheduled for a time of day other than its place in the usual timetable. If school programs are running, sometimes only late afternoon or early evening times may be available.

Also, only a clearly defined timeslot may be available for your display. Thus, the activity at The Cube may need to continue in a different format at another time.

Communicating with a group in The Cube physical environment may become challenging, given the size of the space and that excited participants may be quite noisy. This can limit the amount of verbal instruction that is possible.

Support available

Academics are already stretched to meet their responsibilities. To take on the development of a new instructional tool, they feel the need for help with time, finances, justifications and creative inspiration. Some assistance is possible from The Cube development team. However, they are also under their own pressures. The development team can provide technical assistance, however are dependent on academics for ideas and factual content.

The Cube is a public space whose main audiences are the general public and high schools. A project that caters to those audiences as well as university students can attract more formal Cube support and enable its display in normal visiting hours.

Academics are not aware they can have content on The Cube, so an advertising strategy is needed to attract proposals.

Development timeline

The time it takes to develop a presentation for display on The Cube varies with the kind of project:

- A presentation which is simply a poster display may be prepared within a week, if the materials sent for display are in good order.
- A presentation which is a significant wall-sized presentation (i.e., which incorporates multiple touch panels as well as a projected image on the wall above them) requires a year.

Benefits

Some benefits of integrating The Cube into Higher Education curricula are outlined here, grouped under:

- Visualisation
- Experimentation
- Exploration
- Motivation
- Collaboration
- Adaptability

Visualisation

The Cube provides the opportunity for content to be presented in a visual manner. An example is an aerodynamic model which shows the way air flows over various objects, enabling the student to see airflow and conceptualise the forces at work.

Experimentation

The Cube provides an environment where it is safe to experiment and learn through risk-taking. A student may push a virtual system to breaking point, without fear, loss of life, expense or academic penalty. An example is making fuel mixes for rockets which optimise endurance in relation to performance.

Exploration

The Cube supports learning by allowing easy access to additional information on topics students are interested in or don't understand. It can provide a degree of detail not previously available to the learner. For example, if they come across a concept they aren't familiar with, they can select it and layers of additional information are immediately available.

Motivation

The Cube attracts the attention of students, due to its unique design and technological functions. It is also fun and easy to manipulate and view. This means students may interact with it without realising they are learning in the process. In addition, The Cube can provide the opportunity for students to approach a topic from a different perspective to that taken in the classroom or textbook. An example is incorporating a Cube experience in the midst of a longer workshop, whereby the participants perceive they are having a break when they are actually still engaged with the topic. The teaching team is also inspired by working with the facility.

Collaboration

The Cube provides a working situation where students learn from each other by seeing each other's solutions to problems and through dialogue. The space caters for collaborative ventures which engender teamwork. An example is a team working to code virtual robots to recycle rubbish faster than another team.

Adaptability

The Cube provides for dynamic interactions, allowing individuals to approach the content according to their interests. A student can explore to the depth appropriate to their level of ability. An example is a student may choose to learn about gravity by experimenting with the way objects interact under differing gravitational pulls or by choosing information panels to read about gravity theory.

Strategies

Strategies for integrating The Cube into Higher Education curricula, are grouped here under:

- Community hub
- Resource centre

- Showcase
- Link to other organisations
- Crowd sourcing
- Templates and wizards
- Research tool
- Instructional tool
- Social space

Community hub

The Cube may provide a centralised space for activity which draws on citizen science projects. The data from these projects may be useful for students in their studies. An example is collecting and displaying evidence of koala presence, drawing on reports from the wider community of koala sightings, including a photograph and GPS location.

Resource centre

The Cube could act as a resource centre, presenting core topics for use by many others. Individual academics who don't have the capacity or ability to develop conceptual modules could draw on this resource as they present their units and as academics had ideas for new topics, a central development team could assist them to produce a new module.

Showcase

The Cube may be used to showcase to the wider community the good work QUT students are doing and the good contributions they will be making in the future. An additional benefit of this is the students' cohort can learn from what they see displayed. As others see students' work, they are encouraged to be involved in their education and use what they produce.

Link to other organisations

The Cube may serve as a link to neighbouring organisations. Museums may extend their displays into The Cube space. The different locations could direct visitors to each other. An example is a study of corrosion could be linked to the Maritime Museum across the river, The Cube display providing a representation of the ion interactions happening in different types of corrosion seen on vessels in the museum.

Crowd sourcing

The Cube may be augmented by students developing an additional section for an existing wall display. An example is students creating a new fish species for The Reef.

Templates and wizards

The Cube may have various templates and wizards that make using it straightforward. These could cover booking the space, creating posters and organising events.

Research tool

The Cube could supply user interaction data which is useful for research projects. This may be to do with technological interactions, or on another topic for which a Wall display is developed.

Instructional tool

The Cube could be designed to exploit its strengths as a support to teaching goals. That design may cater to various learning styles and allow learners to approach a topic following many different pathways. It may allow teachers to pursue learning objectives more effectively than using traditional methods. It may provide an engaging environment where students desire to be.

Social space

The Cube may provide a space for students to meet socially, and in at the same time encourage them in their studies. Social interaction is understood to be the reason many students travel onto campus, rather than study. Meeting their felt need can provide an opportunity to encourage them to also meet their study needs.

What the literature says

This section proposes theoretical foundations appropriate to guide the use of The Cube to stimulate learning.

Constructivism has usefully been applied to higher education and provides insights into learning in the context of The Cube.

Alt[2] outlines constructivist principles (p377):

- constructive activity – *learning to learn*, active meaning making, student-generated; *real world orientation*, personally interesting, direct relevance to the learner; *multiple perspectives*, students approach content from multiple points of view, enhances understanding and adaptability; *in-depth learning*, learners draw on existing knowledge to seek clearer understanding, learners creatively apply learning to their future
- teacher-student interaction – *teacher as facilitator*, the teacher is not the sole authority, students provided environment for self-regulated learning
- social activity – *learning is influenced by social factors*, communities of enquiry and dialogue are integral to learning, verbalisation of formative ideas helps refine and reinforce them

When reflecting on constructivism, Ambrose et al.[3] propose seven research-based principles for smart teaching in higher education. The design of learning experiences in The Cube can be helpfully guided by these principles to enhance learning.

1. **Prior knowledge** – Students' prior knowledge can help or hinder learning. Ideally, students build on a foundation of robust and accurate prior knowledge... if students' prior knowledge is insufficient for a task or learning situation, it may fail to support new knowledge... if it is inappropriate for the context or inaccurate, it may actively

[2] Alt, D. (2016). Contemporary constructivist practices in higher education settings and academic motivational factors. *Australian Journal of Adult Learning, 56*(3), 374-399.

[3] Ambrose, S., Bridges, M., Lovett, M., DiPietro, M., & Norman, M. (2010) *How learning works: 7 research-based principles for smart teaching*. San Francisco, CA: Jossey Bass. https://firstliteracy.org/wp-content/uploads/2015/07/How-Learning-Works.pdf

distort or impede new learning. To help students learn, it is important for instructors to (a) clearly explain the conditions and contexts of applicability, (b) teach abstract principles but also provide multiple examples and contexts, (c) point out differences, as well as similarities, when employing analogies, and (d) deliberately activate relevant prior knowledge to strengthen appropriate associations. The dynamic and interactive nature of The Cube can help rapidly situate students to the context, review general principles and provide practical examples, and thus enable them to draw on useful prior knowledge as they focus on the specifics that interest them. For example, The Reef provides a visual orientation to the environment being represented which presents the various elements of the environment and their interactions. Information bubbles provide more detailed information about the elements the students select.

2. **Knowledge Organisation** – Learning content may be organised to allow students to see connections between the different elements of what they are trying to learn, like timelines and graphs, but the interactive element means that you can also manipulate the information to compare elements or perceive change. The Cube enables engaging and logical design which organises learning material in a beneficial way. The Cube can also potentially be programmed to learn from interactions with its interface, to track how a student organises their existing knowledge and to detect gaps in that knowledge.
3. **Motivation** – Students are likely to be motivated to learn when they encounter a learning activity they value, expect to succeed and encounter a supportive environment. The Cube can be thus designed to motivate students to learn. Students who are intrinsically motivated to learn using this tool will persist in independent learning to achieve their goals.
4. **Mastery** – Mastery depends on students acquiring component skills, integrating them, and knowing when to apply what they have learned. The Cube can help students to understand and construct complex concepts from component parts, for example choosing rocket fuel mixes and seeing the consequences of their choices when they launch the rocket. Students can practice these choices by experimentally repeating and adjusting them until they achieve a successful launch. They can then experience the satisfaction of multiple successful launches as they apply the lessons they have learned.
5. **Goal-directed practice** – Practice needs to be focused, accompanied by feedback appropriate to the student's skill level and frequent. The Cube can enable such practice. For example, in the robot activity students receive immediate feedback, whether the robot does what they had intended, which is timely.
6. **Appropriate social, emotional and intellectual environment** – Students are whole, complex people and a positive climate enables them to develop a full range of social, emotional and intellectual skills. The Cube can be used as a tool to engender such an environment, where students are able to engage at a level appropriate to their existing level of maturity. In the robot example, people with limited understanding of coding can get the robot to move quite easily; people with basic coding can use the modular drag and drop coding to program the robots to perform particular actions; people with advanced coding knowledge can compete with another team to make the most efficient program for achieving shared goals.

7. **Self-regulated learning** – Learners are introduced to a suite of approaches to self-monitor, reflect, strategize and adapt their approach to learning. They thus equip themselves to be more effective learners. In the pirate exercise, students learn how to manipulate the device to change the angle and force necessary to hit another pirate ship with their cannons. To achieve that, they need to work out what the goal of the game is, they need to evaluate their existing knowledge of these maths concepts, then they need to devise a plan and monitor their progress as they aim their cannons. These concepts are associated with the creation and maintenance of self-regulated learning because the students are responsible for devising their actions at each stage.

While The Cube has potential to contribute positively to students' learning, activities on it need to be intentionally designed in the light of the above principles in order to maximise its usefulness as a learning tool.