
The Sat-Comms Game: teaching a complex subject for interdisciplinary audiences

Dr. Paul ILIFFE¹

Abstract

This paper addresses general space education for interdisciplinary audiences. In particular, this paper considers education in the field of Satellite Telecommunications (Sat-Comms).

The challenge in presenting the field of sat-comms for effective learning is two-fold. Firstly, this field is interdisciplinary, the disciplines are coupled, and it is complex. Secondly, the typical audiences for this subject often have diverse backgrounds. Hence, a suitable teaching strategy is required, so that all students can learn from a training session.

Publicly available sat-comms training is largely engineering focused. This study could not find suitable training for the purpose of interdisciplinary sat-comms education.

Hence, to address this absence in available training, the author has created a workshop, which provides sat-comms education to interdisciplinary audiences. The workshop was empirically developed from the author's experience at Inmarsat and at the International Space University. The workshop uses elements from Constructivist, Behaviourism, Cognitive, Connectivism, and Experiential learning theories. Furthermore, it was designed to be taught in person and online.

The Sat-Comms Game was first trialled in an online format in 2021. The workshop worked well in engaging the participants during the session. Additionally, feedback on the workshop was positive. Hence, this trial indicated that the workshop could function logistically and engage people pedagogically.

The author intends to conduct further trials and corresponding assessment methods to gauge the pedagogic effectiveness.

Keywords

Interdisciplinary Space Education, Satellite Telecommunications, Student focused teaching

¹ Corresponding author: Creator of The Sat-Comms Game, paul.iliffe@community.isunet.edu

include poorly structured learning content, insufficient deconstruction of concepts, and lack of engagement between the students and teachers.

In an attempt to provide more effective education in sat-comms, the author has combined his academic, professional and personal experiences. Inspiration was taken from the author's work at Inmarsat to support the workshop for new employees, to provide outreach work to primary school children, and to produce training material for the spacecraft operations team.

Inspiration has also been taken from the author's experience in Ballroom Dancing and in Athletic Conditioning programmes. Both of these disciplines make effective use of deconstructed information and experiential learning.

Furthermore, the author refined the approach in interdisciplinary lectures to MSc students at the International Space University (ISU), from training in facilitation skills by Integrated Works (a leadership and development consultancy), and from applying these facilitation skills at the ISU's Space Studies Programme (SSP) 2021.

3.3. Key challenges

There are three challenges in the delivery of the Sat-Comms Game: engagement, simplicity of information, and learning through play.

Engagement

In the author's experience of tertiary and professional education, engagement by the students is often lacking. Students are frequently subjected to excessively detailed and lengthy presentations and are, therefore, mostly passive during such sessions. This is not conducive to engagement.

In the Sat-Comms Game a set of approaches are taken to encourage and necessitate engagement. Before the session starts four images are presented together with a question. The question asks the students to select an image, which best reflects their state of being. For example, during the SSP'21 event the question was "Which image best represents how you feel about SSP'21 so far?". In this case the images included a martial artist, Kung-Fu Panda, a distressed looking infant, and an excited Lego figure. The purpose of this approach is to encourage communication between the students and workshop lead and thereby remove any psychological barriers to communication.

Simplicity and deconstruction of information

The sat-comms sector is complex. From the perspective of a layman, this complexity can be confusing and is not conducive to quick understanding. The appropriate simplification and deconstruction of information lend themselves to more effective learning.

The deconstruction of information in learning is exemplified by Josh Waitzkin in his book *The Art of Learning*. Waitzkin describes how he studied the endgame in chess. In such endgames, there may be only three pieces on the board: both kings and a pawn. The simplicity of this configuration is conducive to the study of certain chess principles, such as empty space and zugzwang (4).

In a similar manner to the chess example above, in the Sat-Comms Game a number of simplifications are made. Only a few details are given about ground and space-based hardware, the physics of signal propagation, orbital mechanics, spacecraft and launcher costs, and the global sat-comms market.

Learning through play (a.k.a. accepting wrong answers)

After years of social conditioning, adults are often reluctant to play. Learning through play for adults, therefore, can be challenging. To overcome the resistance of adults to play, The Sat-Comms Game is structured such that any solution is considered. It is imperative for the workshop lead to accept ideas, which would probably not survive contact with reality, and to subtly suggest amendments to the idea. The workshop participants must use their imaginations and not be given solutions.

3.4. Application of learning theories

Although The Sat-Comms Game was empirically developed, it has come to embody a set of learning theories. These theories and their application in the workshop are described below.

- Constructivist

According to the Constructive learning theory, people learn based on experience and learning is a process of active engagement [5]. In The Sat-Comms Game the participants are required to create their own sat-comms organisation. Participation is integral to the activity.

- Behaviourism

This theory states that positive and constructive feedback is essential for effective learning. This

feedback reinforces the efforts made by the learner and, hence, encourages the continuation of these efforts [6]. In The Sat-Comms Game the workshop lead provides positive feedback to the participants to reward them for the thinking process, not so much for the proposed ideas.

- Cognitive

According to Cognitive learning theory, the way in which a person learns (the cognitive process) is key. Humans construct bundles of knowledge in the mind and learn through active discovery [7]. In The Sat-Comms Game, the participants are required to quasi-independently search for solutions, to try and to fail, and, to think openly. Their thought process is emphasised above the results.

- Connectivism

According to the Connectivism learning theory, people learn and grow, when they form connections between different fields and ideas, when there is diversity of opinion, and when decisions must be made [8]. The basis of The Sat-Comms Game is to guide the participants to understand the connections between the various elements of the sat-comms sector. Participants must assess these connections, make decisions, and present their ideas amongst and array of others.

- Experiential

Like Constructivist learning theory, Experiential learning theory also emphasises the importance of learning by doing, that is learning through experience. In this case, the learning process is cyclical and passes through four phases: concrete experience, reflective observation, abstract conceptualisation and active experimentation [9]. The Sat-Comms Game utilises a cyclic approach of similar structure. Participants must learn the key concepts, conceptualise sets of ideas, experiment by combining the ideas, and reflect upon their ideas following feedback.

3.5. First trials

The Sat-Comms Game was first trialled at the ISU's Space Studies Programme (SSP) July 2021. In this case, two workshops were run in an online format, whereby participants joined via Zoom. Both sessions were two hours in duration. A Teaching Associate from ISU supported the workshop by conducting the Zoom administration and by distributing the files with instructions. This support proved to be essential.

Feedback from the participants was very positive. In a post-workshop survey on a three point scale (poor – good – excellent), 100% of respondents from the first workshop and 88.9% from the second workshop rated the sessions as excellent. One respondent included the following note:

“One of the best courses during SSP21. The lecturer motivated us to use our critical thinking through very useful activities.”

This trial indicated that the workshop could function logistically and engage people pedagogically.

3.6. Future objectives

The author intends to conduct further trials of The Sat-Comms Game, in particular with employees of a sat-comms organisation. To assess the effectiveness of the workshop, it is proposed that the participants complete pre- and post-workshop questionnaires. Furthermore, the effectiveness could be assessed by also conducting questionnaires with non-participants.

4. Conclusion

In summary, this paper presents The Sat-Comms Game, which is a new approach to teaching people about sat-comms. This approach is empirically based, is appropriate for interdisciplinary audiences, and can be taught both online and in person. The first trial of the workshop indicated that it is effective in presenting the topic of sat-comms. The author intends to conduct further trials and corresponding assessment methods to gauge the pedagogic effectiveness.

If you would like to run The Sat-Comms Game at your organisation or to improve your organisation's training, please feel free to get in touch with the author via the provided email address.

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