Using a gamification framework to increase student engagement with groupwork: 'Alien Alliance' - a boardgame for a range of scenarios.

Manjot Brar, manjotkb@outlook.com
Catherine Douglas, catherine.douglas@newcastle.ac.uk
Elisa Lopez-Capel, elisa.lopez-capel@newcastle.ac.uk
Jeremy Franks, Jeremy.franks@newcastle.ac.uk
Simon Parker, simon.parker@newcastle.ac.uk
NB: All authors are affiliated to Newcastle University.

Student interns: Robin Goode, Finn Mawer, Yihan Shi, Stefania Bilca, and Jonathan Dodd

Abstract

Feedback from end of module forms and focus groups with students studying a range of degrees in the 'School of Natural and Environmental Science', at Newcastle University, identified a need for additional support in preparation for groupwork. This need is consistent with issues raised in a range of studies carried out in higher education contexts where barriers, such as social loafing and difficulty communicating, prevent students from engaging with groupwork and leave them feeling unprepared for future scenarios. This suggests the onus lies with universities to improve teamwork education, particularly important as collaborative skills are considered essential by prospective employers.

To address student dissatisfaction staff saw the value in an active approach to honing teamwork skills, as opposed to listing off a series of 'dos and don'ts' in lectures and aspired to adopt the framework of gamification, which has been demonstrated to be effective in shaping and training participant behaviour in a range of educational scenarios.

Staff successfully bid to the Faculty Educational Development Fund to employ 6 student interns to co-develop a tool that would help tackle common issues associated with group work and subsequently increase student engagement with it. A sci-fi themed boardgame, named 'Allien Alliance' was designed over 4 weeks. The game was created with the aims of providing students with take-away tips for future teamwork, to act as a fun icebreaker that develops student confidence and communication and a subsidiary aim of integrating aspects of equality, diversity and inclusion (EDI)/intercultural competence. A 4-minute animated video outlining the game (supplementing the instruction booklet) is available to give a visual description of the project and insight into the game. Please view on https://www.youtube.com/watch?v=h4u1rcSE55U

Alien Alliance was piloted at a widening-access-and-participation summer school as well as trialed across stage 1, 2 and 3 undergraduate modules at Newcastle University, with applications identified in engineering, medicine and languages. Feedback collated via Microsoft forms from students and staff demonstrated that this co-designed activity was

considered a fun tool that has the potential to provide takeaway tips for future group work and definite ability in improving student confidence and communication by acting as an effective icebreaker. Comparison of module feedback from one year to the next on a large teamworking module also indicated that the game had reduced the number of teamwork related complaints.

This case study demonstrates that a gamified teaching resource can improve student engagement with teamwork. Alien Alliance has been widely used and is now embedded in a range of scenarios within our School and wider university including transition to higher education summer school, undergraduate and postgraduate students. The game provides a strong foundation from which further, improved versions can be developed. An abridged version has been produced for very short sessions, and the icebreaking cards have also been used in a range of independent scenarios. Future study could aim to improve our present data analysis methods to be more robust and generate further supporting evidence for the strengths and limitations of the game as well as focus on sampling underrepresented groups such as international students and those with special educational needs.

Description of Project

Background and Context

Teamwork refers to the 'process of working together with a group of people in order to achieve a common goal' (Johnson and Johnson, 1996) or

> *"shared creation with two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have come to on their own"* (Schrage, 1990, p.40).

It underlies multiple domains of life, both academically and professionally. 'Groupwork' specifically can be defined as

> *"teaching or learning in a group setting with the aim of developing students individually through group cooperation*" (Collins, 2023)

Within higher education, groupwork is often implemented to foster students' 'collaborative' skills, a key component of graduate frameworks nationally (National Teaching Fellow, 2017). Collaboration fuels innovation, aids self ~ and social development and allows common goals to be reached (Fay et al., 2014) and is therefore an important aspect of learning. Collaborative skills are consistently cited by employers as essential rather than desirable criteria when recruiting for employees, as found by a systematic review of teamwork pedagogy (Riebe, Girardi, and Whitsed, 2016). A computer-based survey with 540,000 students from OECD countries in 2015 suggested that on average 85% considered teamwork skills to be valuable (PISA, 2018). However multiple studies have shown that despite students understanding the benefits of groupwork and the transferrable skills it brings, there are many students who consider

they have ‘done’ teamwork, have resistance to it, and do not value skills development as much as knowledge acquisition (Watson et al., 2022). In addition, there are challenges that can create barriers to students engaging with groupwork-orientated tasks in university and gaining these benefits in practice (Wilson et al., 2017).

Within a Newcastle University context, feedback relating to group tasks associated with assessment identified common issues. Barriers to students engaging included finding it difficult to work with people they do not already know (reflecting poor communication skills and inability to find strategies to build rapport) and social loafing. The latter refers to the presence of ‘free-loaders’, whereby certain members of the team are not ‘pulling their weight’ and is consistent with research that identifies the phenomenon as the most significant concern for students in relation to teamwork (Garcia-Bayonas and Gottschall, 2008; Pfaff and Huddleston, 2003). Social loafing could be a result of reduced social pressure on the individual but may also be a symptom of other problems such as a lack of clarity on the group task, its aims and how to assign roles, potentially reflecting issues with teacher guidance (Oakley et al., 2007). Additionally, studies have identified schedule conflicts (Burdett, 2003), unfair grading (Curşeu, 2011) and a preference for working individually (Garcia-Bayonas and Gottschall, 2008) as barriers for teamwork. Issues such as these also have knock-on effects on staff time and morale.

Further, group working within a professional workplace context is likely to pose different and more challenging issues than that conducted within a higher education context. For example, in the workplace teamwork is usually more long-term, with individuals having direct stakes to the outcomes and a greater onus is placed on individual accountability compared to a university classroom context (Berge, 1998).

Watson et al. (2022) identify an urgent need to address teamwork with little progress made to date in teamwork education. This was reiterated in a study involving 201 undergraduate social science students (Wilson et al., 2017) and another involving 400 undergraduate science students (Varsavsky et al., 2014), where a majority felt their degree did not sufficiently prepare them with teamwork skills for the future. Additionally concerning is the finding that often there are discrepancies between student perceptions of their teamwork skills and employers’ perceptions (Pereira et al., 2013), which suggests there in an imbalance between the skills workplaces expect and what universities are developing.

It is also important to consider student engagement with teamwork through an EDI lens. Being a student who is in an under-represented group, e.g. international, neurodivergent or those with mental health conditions such as social anxiety can pose unique and often more challenging barriers to a student engaging, particularly relating to communication (Gorgan, 2015). There is a need to account for these differences and ameliorate the impact when aiming to improve groupwork.

The above issues highlight a need for teamwork training within learning contexts. This was reiterated during an international student focus group at Newcastle University, where participants were asked about their experiences involving group work. Students

requested support in preparing for group work and suggested that talking through potential scenarios would be beneficial. This was also raised in Student Staff Committees and led a small team of 4 academics, with input from several other stakeholders, to consider gamification as a tool to promote engagement, rather than a list of 'dos and don'ts' in a lecture or a resource available to read through on the VLE (virtual learning environment).

Gamification rationale

Gamification is a framework considered useful for shaping and training participant behaviour that has at its core the concepts of entertainment and engagement (Tulloch, 2014). As games are inherently pedagogic systems that have the benefit of training players in the 'correct practice' of sophisticated concepts i.e. good teamwork etiquette, whilst also maintaining interest via the use of entertaining game design elements (Challco et al., 2014), gamification is a powerful tool to increase student engagement. Not only does framing the task as a game make the learning experience more meaningful but its psychological effects also significantly increase enjoyment (Lieberoth, 2015).

While a lecture on 'preparing for groupwork' could deliver some example scenarios and ways to tackle issues, a game engenders learner participation, triggers interaction and the creation of social support networks (useful for success at university). This allows a game to act as an effective icebreaker, encouraging people to communicate and increasing individual confidence, especially in students who may be shy. Considering confidence and the ability to communicate are essential prerequisites for productive teamwork, these foundational traits need to be targeted in any initiative that hopes to improve teamworking skills. Students will also experience perspectives they may not usually encounter, allowing them to recognise 'equal but not the same' contributions from others.

Additionally, gamification can potentially allow students to learn through experimenting and retrying without fear of negative consequences. Currently few game activities in learning facilitate this potential for low stakes failure (Dichev and Dicheva, 2017). Thus, a game may serve as a safe space to explore issues and may reduce anxiety around group working.

Dichev and Dicheva (2017) also note that while gamification has been adopted to support learning in a variety of contexts and subject areas, there is a low proportion of studies on gamifying STEM (Science, Technology, Engineering, Maths) disciplines.

While we hope the game intervention benefits all students, it may be a particularly helpful way of integrating international students, whilst also enabling elements of intercultural awareness, as well as EDI, to be incorporated. Dichev and Dicheva's (2017) review of the literature only found one study with an international perspective reporting on Asian student involvement.

Project Aims

In response to the students' requests for more help with group work, staff at Newcastle University successfully bid to the Faculty Educational Development Fund to employ 6 student interns to co-develop a tool that would increase student engagement with groupwork.

Newcastle University students were recruited (via advert and interview) from across a range of disciplines (humanities, arts, medicine, science, maths and social science). Their remit was to co-design a boardgame over 4 weeks to be piloted at the widening-access-and participation summer school, with the following aims:

Aim 1: To provide students with take-away tips for future teamwork.

Aim 2: To act as a fun icebreaker that develops student confidence and communication.

A subsidiary aim: if possible, to integrate aspects of EDI/intercultural competence.

Alien Alliance

The student interns trialed several board games, shared experiences of playing them and their individual skills. From the brief related to the aims, and examples from staff, they synthesised the concept and design. The board (see appendix figure A1) visually represented a 3-week assignment and reflected Tuckman's processes of forming, storming, norming and performing (Tuckman, 1965, Table 1) to enhance students' knowledge of the process of working together.

Table 1: Tuckman's processes of forming, storming, norming and performing

Tuckman process	Description
Forming	agree goals, timelines and divisions of tasks
Storming	conflict and tension
Norming	resolving conflict; agreement and consensus formed
Performing	successfully implementing and sustaining behaviours

Each tile on the board was designed to reflect a day of the project where players were required to pool resources (reflecting different skills, see appendix figure A2), to strategically problem solve a range of different tasks (see appendix figure A3) in an escape-room-type scenario. To move forward and gain points the players had to work together to produce a resolution to these scenarios by offering to contribute resource cards. For example, if the scenario presented was two team members having a

disagreement about their section of the project, communication and adaptability resource cards would be productive in moving forward.

Resources were allocated to players according to their randomly assigned Belbin role (Belbin, 1993). The Belbin team roles (nine different clusters of behavioral attributes, see appendix example figure A4) were used as exemplars to teach players about the varying skills different team players can bring and pushed students to think about the type of team player they were. For example, the 'implementer', an individual who turns ideas into practical solutions was allocated a practicality resource card.

Background cards were also assigned e.g., having a part-time job, which can limit or increase the resource cards of a player to reflect real life scenarios and add more personality to the role (see appendix figure A5). Discussion cards (see appendix figure A6) were included periodically on the board to initiate time-constrained decision-making processes, as well as 'group meetings' to resolve any previous discussions and evaluate or swap resources. This mimics how in real life scenarios tasks may be re- delegated and allowed students to take away strategies for future team projects both in the academic and professional world.

It is the appropriate allocation of resources in the face of different scenarios and resolution of discussions that leads to outcomes that enable or set back progress around the board. Thus, these discussion and scenarios cards acted as vehicles for exploring topics such as peer review, inter-cultural competency, EDI, key university processes and regulations, good academic practice as well as engagement with feedback. This also makes the game tailorable for a range of purposes and valuable for more general induction activities, useable by any discipline. The literature suggests that the more game elements included, the more engaging the game. A situation where more is more.

The board also included an introduction starting space to encourage players to get to know each other supported by question cards around common interests (see appendix figure A7). This was to target our aim of encouraging the development of individual confidence and communication skills in a group context. Additionally, each player was assigned a unique alien character, creating a background story to the game to increase interest in playing, as well as represent nuanced diversity.

A more detailed and visual explanation of the game can be accessed in a four-minute video (see appendix figure B1 to scan QR code).

Findings and Reflections

Pilot with year 13 students (age 17-18)

The game was piloted by sixth form/college students at the PARTNERS Academic summer school, which is one of the longest-running, supported-entry-route to higher education for

widening access students. Initial impact was assessed via qualitative feedback forms (n=24 of 34). The comments were 100% positive. They noted the following reflections in relation to our aims.

For providing take-away tips for future teamwork:

Most students agreed that the game was successful in promoting good teamwork etiquette within players. For instance, it encouraged people to “work as a group to resolve dilemmas” and many felt they learnt “new skills needed for teamwork”.

Students saw the value of a gamification framework, as it encouraged students to take risks, increasing their chances of learning as there is no pressure of judgement as there can be in learning environments. Other insightful comments included:

> *“helped provide an opportunity to practice communication and team skills with new people in new environments, without the pressure of failure.”*

Another benefit was that the game acted as a social trigger and so allowed communication skills to be developed in students (a key skill for future teamwork), especially in those who usually prefer to work alone.

> “*communicating with a new group of people, understanding different points of view”*
>
> *“it helped to make new friends and learn more about group communication especially from my point of view where I am more independent”.*

The scenario cards used were considered “very realistic” even “perfect”. They brought “light to uneasy situations” and pushed individuals to think about potential group work scenarios that they might not have otherwise considered, “whilst maintaining a light-hearted environment”. This suggests the game provides a foundation for future group work preparation.

> *“sparked helpful discussion...in a light and friendly environment”*
>
> *“made [them] think of scenarios [they] wouldn’t usually think into.”*

As an Ice breaker:

Students unanimously agreed that the game was effective as an icebreaker (see figure A7 for example introduction questions), encouraging the whole group to communicate, with particular benefits for “quieter students” noted. This suggests the set-up of the game was effective in promoting confidence and communication, integral components for student engagement with groupwork.

> *“it helped in taking part in group discussions. Since everyone took turns it helped provide that time to have input in group situation, which may not be there otherwise”.*

The notion of improved confidence was identified as a key take-away benefit from many different students.

"realised speaking in a big group isn't the end of the world".

"improved confidence in speaking in groups".

The introduction stage questions were regarded as an effective way to ask about other people's lives, confirming the value of inclusion in the board game. The interns designed these to be inclusive topics which avoid social barriers that otherwise may prevent easy communication. The concept of the game was also considered "fun" and "unique".

"good way to ease into a project with people you didn't know"

Stage 1, STEM student feedback

Staff have piloted the game in several scenarios including in small groups in personal tutoring sessions to get to know other Stage 1 students, which is now embedded for future years. Other uses include the resource cards that can be shuffled and used to put students in random groups and the introduction cards that can be used as a quick icebreaker when circumstances do not allow for the full game. A feedback QR code is attached to each game set, and table 2 shows the voluntary feedback from students that played the game across various modules. Results indicate that the game provided some help with future group work and worked well as an ice breaker. Additionally, on average students enjoyed the game 'somewhat' to 'quite a lot'.

Table 2: Average score rated by students (1 = none at all, 2 = a little, 3 = some, 4 = quite a lot, 5 = a lot) (n=13)

Question	Mean Response
Did the 'introduction' ice breaker questions get everyone talking in the group?	3.7
Did you feel the game will help with future group work?	2.5
Did you enjoy the game?	3.5

Written feedback from students provided insight into how the game could help with teamwork. Many students commented on its ability to get people talking, enhancing communication between the group via discussions, and increasing the confidence of individuals to talk to others as it allowed students to get to know one another. This led to "group bonding". The role of introduction cards was considered essential for this, and many students reflected on their enjoyment of them. Two students also highlighted the especially beneficial nature of the resource cards, with one commenting insightfully on how they provided an understanding of the unique abilities individuals bring to a team.

Other students alluded more generally to the acquirement of “professional skills”, with another agreeing that the game was “useful for future projects”.

> *“The concept was strong, the theme was fun and the board is an interesting layout. I appreciate how it tries to encourage team discussion and everyone getting involved”*

Constructive criticism was mainly regarding the confusing nature of instructions (subsequently revised, and some staff had not followed instructions to direct students to the QR code video in the first instance). Some students also commented on the fact the game worked better as an ice breaker, rather than a tool for providing takeaway tips on group work, reflected by other students who believed the scenario cards (relinquishing pre-determined ‘resource’ cards) were not as good as the discussion elements. Future developments of the game will prioritise this as an area of focus.

Trialing the game in a large, multidisciplinary Stage 2 module

The game was piloted in a 200 student Stage 2 module with assessed group work in a progressive module using new groupings of students from diverse degrees, engaging with industry representatives. The module leader was one of the academics involved in this project as she intended to use some group working interventions to enhance the module in response to some student dissatisfaction regarding group work.

To assess its impact, the number of complaints in module feedback forms were compared across two academic years focusing on comments associated with the experience of being in a team (such as unequal workload dynamics and difficulty working with people from other disciplines). Table 3 shows the reduction in group work issues.

Table 3: The number of teamwork associated complaints via feedback forms and emails for Sustainable Solutions module across two academic years.

Academic Year	Number of Complaints	Reason for Complaint
21/22	21	- Team related (x21) - Session structure related (x5)
22/23	8	- Team related (x8) - Session structure related (x19)

There were, however, a significant number of additional session-structure complaints concerning the fact that the students had not been able to play the game with the group that they ultimately worked with. A timetabling issue meant there was a first play of the game to get to grips with it with random people, but this was not succeeded with the session where students played it with their actual group, as planned. However, the high interest from students to play the game with their actual group was interpreted as success in relation to the perceived enjoyment and impact of the game. We attribute the lower overall groupwork complaints to be a result of students being able to trial techniques with other students and then use what they had learned with their new group.

Reflections with Stage 3 module

The game was also implemented in a stage 3 module where students are asked to prepare and run a conference. Given the varied nature of tasks and the need to meet deadlines, gelling as a team at the outset is important. While some will know of each other from earlier in their degree, they may not have spoken, equally students from different degrees may be working with others for the first time. Thus, the game was used in this cohort to instigate a 'fresh start' and opportunity to re-calibrate.

As well as an ice-breaker tool, the game acted as an activity that allowed stage 3 students that already have experience of group work from the stage 2 module (without the help of the game) to enhance their skills. As the game incorporates practical experience and the chance to reflect on individual performance in a team, this was effective preparation before putting into practice group work graduate skills in running a conference.

Staff feedback

Following a workshop at Newcastle University's Learning and Teaching Conference, where the game was presented to and played between staff, feedback was collated. As seen in table 4, on average staff thought the game worked well both as an ice breaker and as a tool to help students with future group work. Additionally, staff indicated they would be quite likely to use the game with students (with the caveat that not all staff had access to groups of students where this might be appropriate, for example, professional support staff with administrative roles).

Table 4: Average score rated by four members of staff (1 = none at all, 2 = a little, 3 = some, 4 = quite a lot, 5 = a lot) (n=4)

Question	Mean Response
Did the 'introduction' ice breaker questions get everyone talking in the group?	4

Did you feel the game will help students with future group work?	4
Are you likely to use this game with your students?	3.5

Written feedback from staff expressed that they would be likely to utilise the game in teaching sessions that involved groupwork, transition events and career workshops.

One staff member highlighted the value of the game for neurodivergent students. For example students with autism and anxiety had been observed to engage more with groups than previously observed. Many students experiencing conditions such as these, often find group work more difficult, equally neurotypical students need strategies to integrate neurodivergent students, as both parties may otherwise find these situations awkward and reduce their engagement. Indeed, another staff member reflected that a particular strength of the game was its incorporation of an alien race, which "levels the playing field and avoids stereotypes". This suggests the game may be successful in addressing student engagement barriers for diverse demographics of students.

Constructive criticism was related to the applicability of the game being dependent on the amount of time available with the student cohort, especially as the game is time consuming. However, one staff member considered the game "still worthwhile even if you don't finish". A short-cut option has since been incorporated.

Follow up and Future Plans

The game is now in its second academic year. Due to the predominantly positive feedback from students and staff, and the increased uses that have been found, the game has been embedded in many scenarios. These include a new 150+ student cross-disciplinary Stage 1 module where group work is required, the original interdisciplinary module with industry engagement which is now compromised of 300 students and trialing with post-graduate students as a structured 'getting to know each other' activity. An abridged version has been created, and packs of introduction cards can be used as standalone icebreakers when time is restricted and interactions need to be facilitated, e.g. inductions.

The game has sparked interest through a write-up on the Learning and Teaching Development Service case studies webpages and a workshop delivered at the Learning and Teaching Conference, which is a workshop for staff new to lecturing to consider innovations in learning and teaching. It has also been used in Modern Foreign Languages, Business, one student (also one of the interns) has recommended it for use in his medical degree to use to enhance communication skills, and another member of staff in Engineering hopes to use it instead of quiz night on a residential field trip. Thus, as well as considering this a successful intervention in meeting the project aims, it has also been of benefit to others, and we would be happy to share the resources with anyone

who thinks this might be a useful approach for their group work.

Future developments could utilise focus groups to generate richer data surrounding the specific facilitators and barriers of the game in increasing engagement with teamwork. As staff recognised more consistently than students that the game would help with future scenarios, it would have been beneficial to explore the reasons for this difference as well as understand why students found the game to be less effective in reaching this aim compared to the icebreaker aim. This would aid our understanding of the game's strengths and limitations and allow us to improve further editions of the game.

A follow-up, reflective activity with the students may strengthen students' appreciation of the value of the activity too, indeed a skills e-portfolio is being implemented and these reflections could form a part of this. Watson et al (2022) note that while students' perceptions of group working demonstrated superficial understanding at the outset, subsequent interviews on students' reflections of groupwork skills interventions demonstrated a richer appreciation of the learning points and skills development.
Reflections could be captured as part of a reflective assessment. In addition, students could become part of a follow-up study when they enter the workplace to identify whether there are subsequent perceived benefits. However, Watson et al.(2022) note that as educators we can recognise the value of transferable skill education whereas our students might not immediately recognise the relevance.

Additionally, to gain a more empirical assessment for the effectiveness and impact of the game, Likert point survey questions could be administered to students before and after playing, where participators rate their levels of confidence, preparedness for future scenarios, and skills in relation to teamwork. Paired T-tests could then be run to gauge whether a significant difference in scores has occurred as a result of the game. In addition, robust randomised control trials could be conducted, where some modules implement the game, whereas others do not allow comparisons to be made in regard to students' engagement with teamwork as well as staff/student satisfaction with the module. Although we attempted to compare responses from one year without the game to the subsequent year with the game, a more robust study is needed to minimise the impact of extraneous variables and ensure validity of results.

Further developments could focus more on addressing the EDI aims of the game by for example sampling higher numbers of students from ethnic minorities and those with special educational needs and disabilities to assess whether the challenges they face and the benefits they get from the game are unique in any way. Although staff and student feedback mentioned some benefits of the game associated with EDI elements and marginalised groups, this was minimal.

There is also scope for QR codes to bring online content, which makes it very flexible for adding bespoke content, more scenarios or digital resources in the future. There has also been interest from Newcastle University's School of Computing in producing an app for the game, which could address the time constraint issues cited in the feedback and allow greater collaboration at distance, e.g., Open University/distance learning. It could also

be trialed in general workplaces or other educational settings, e.g., prisons.

Conclusion

The overall aims of the game 'Alien Alliance' were met, with students and staff perceiving the board game as having potential to provide useful take-away tips for future group work as well as being an extremely effective ice breaker that developed communication skills and confidence. Thus, this case study shows a gamified tool has great potential to increase student engagement with groupwork. Although not perfect, the current board game provides an excellent foundation from which further developments can be made. This case study also hopes to enthuse others thinking of conducting similar projects to give it a go, and to address the dearth of well-designed studies for publication into gamification especially in STEM disciplines.

References

Belbin, M. (1993). *Team Roles at Work*. Oxford: Butterworth-Heinemann.

Berge, Z. L. (1998). Differences in teamwork between post-secondary classrooms and the workplace. *Education & Training, 40*(5), 194–201. https://doi.org/10.1108/00400919810220761

Burdett, J. (2003). "Making Groups Work: University Students' Perceptions." *International Education Journal* 4: 177–191.

Challco, G.C., Moreira, D., Mizoguchi, R., & Isotani, S. (2014). Towards an Ontology for Gamifying Collaborative Learning Scenarios. In: Trausan-Matu, S., Boyer, K.E., Crosby, M., Panourgia, K. (eds) Intelligent Tutoring Systems. ITS 2014. Lecture Notes in Computer Science, vol 8474. Springer, Cham. https://doi.org/10.1007/978-3-319-07221-0_50

Collins English Dictionary (2023). Definition of 'groupwork'. Collins. https://www.collinsdictionary.com/dictionary/english/groupwork#:~:text=noun,students%20individually%20through%20group%20cooperation

Curşeu, P. L. (2011). "Intra-group Conflict and Teamwork Quality: The Moderating Role of Leadership Styles." Administrative Sciences 1: 3–13. https://doi.org/10.3390/admsci1010003

Dichev, C & Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: a critical review. *International Journal of Educational Technology in Higher Education* 14:9. https://doi.org/10.1186/s41239-017-0042-5

Fay, D., Shipton, H., West, M., & Patterson, M. (2015). Teamwork and Organizational Innovation: The Modeling Role of The HRM Context. *Creativity and Innovation Management.* 24(2), 261-277. https://doi.org/10.1111/caim.12100

Gottschall, & Garcia-Bayonas, M. (2008). Student Attitudes towards Group Work among Undergraduates in Business Administration, Education and Mathematics. *Educational Research Quarterly*, *32*(1), 3–28

Grogan, G. (2015). Supporting Students with Autism in Higher Education through Teacher Educator Programs. *SRATE Journal*, 24 8-13.

Healey, M., Flint, A. & Harrington, K. (2014). Engagement through partnership: students as partners in learning and teaching in higher education. https://www.heacademy.ac.uk/engagement-through-partnership-studentspartners-learning-and-teaching-higher-education

Hernández-March, J., Martín del Peso, M. & Leguey, S. (2009). Graduates' Skills and Higher Education: The employers' perspective. *Tertiary Education and Management,* 15 (1), 1–16 https://doi.org/10.1080/13583880802699978

Johnson, D.W. & Johnson, R.T. (1996). "Cooperative learning and traditional American values: an appreciation", *NASSP Bulletin,* 80(579), 63-65

Lieberoth, A. (2015). Shallow gamification – psychological effects of framing an activity as a game. *Games and Culture*, 10(3), 249–268. https://doi.org/10.1177/1555412014559978

National Teaching Fellow (2017). Graduate attributes framework. AdvanceHE. https://www.advance-he.ac.uk/knowledge-hub/graduate-attributes-framework

Oakley, B., D. Hanna, Z. Kuzmyn, & Felder, R. M. (2007). "Best Practices Involving Teamwork in the Classroom: Results from a Survey of 6435 Engineering Student Respondents." *IEEE Transactions on Education* 50: 266–272. doi:10.1109/

TE.2007.901982

Pereira, O. (2013). Soft skills: From university to the work environment. Analysis of a survey of graduates in Portugal. *Regional and Sectoral Economic Studies*. 13. 105-118.

Pfaff, E., & Huddleston, P. (2003). Does It Matter if I Hate Teamwork? What Impacts Student Attitudes toward Teamwork. *Journal of Marketing Education*, 25(1), 37-45. https://doi.org/10.1177/0273475302250571

OECD Programme for International Student Assessment. (2018). *PISA 2015 Results in Focus.* https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

Riebe, L., Girardi, A., & Whitsed, C. (2016). A Systematic Literature Review of Teamwork Pedagogy in Higher Education. *Small Group Research*, *47*(6), 619-664. https://doi.org/10.1177/1046496416665221

Schrage, M. (1990). *Shared Minds: The New Technologies of Collaboration*, Random House, New York, NY

Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin, 63*(6), 384–399. https://doi.org/10.1037/h0022100

Tulloch, R. (2014). Reconceptualising gamification: play and pedagogy. *Digital Culture & Education*, 6(4), 317–333.

Varsavsky, C., Matthews K., & Hodgson Y. (2014). Perceptions of Science Graduating Students on their Learning Gains, *International Journal of Science Education*, 36:6, 929-951, DOI: 10.1080/09500693.2013.830795

Watson, H. R., Dolley, M. K., Perwaiz, M., Saxelby, J., Bertone, G., Burr, S., Collett, T., Jeffery, R., & Zahra, D. (2022). 'Everyone is trying to outcompete each other': a qualitative study of medical student attitudes to a novel peer-assessed undergraduate teamwork module. *FEBS open bio*, *12*(5), 900–912. https://doi.org/10.1002/2211- 5463.13395

Wilson, S., Ho S., & Brookes, R.H. (2017). Student perceptions of teamwork within assessment tasks in undergraduate science degrees. *Assessment & Evaluation in Higher Education.* DOI: 10.1080/02602938.2017.1409334

Appendix A

Figure A1: Alien Alliance Board

Figure A2: Example resource cards

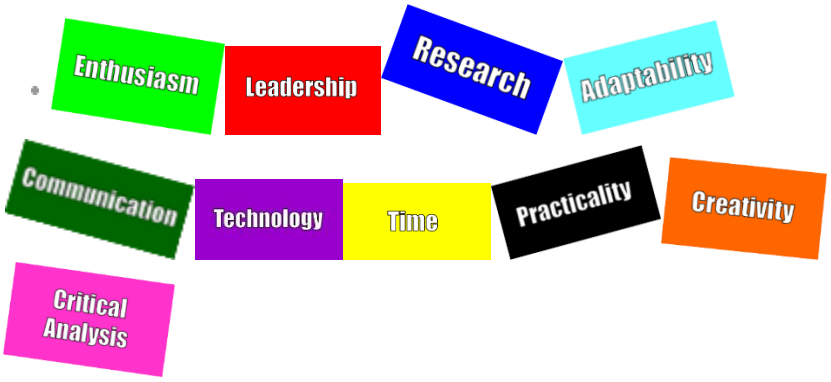

Figure A3: Examples of scenario cards and the group or individual resources required to resolve them and gain or lose points (which dictate final degree classification). The colours related to pre-determined skills set to highlight the range of skills used in teams.

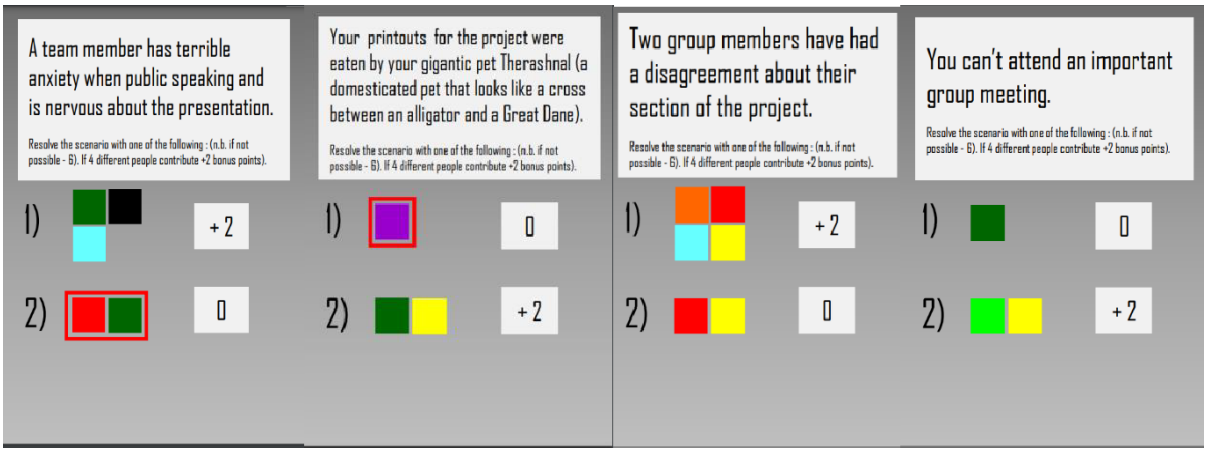

Figure A4: Example of Belbin-style team role card

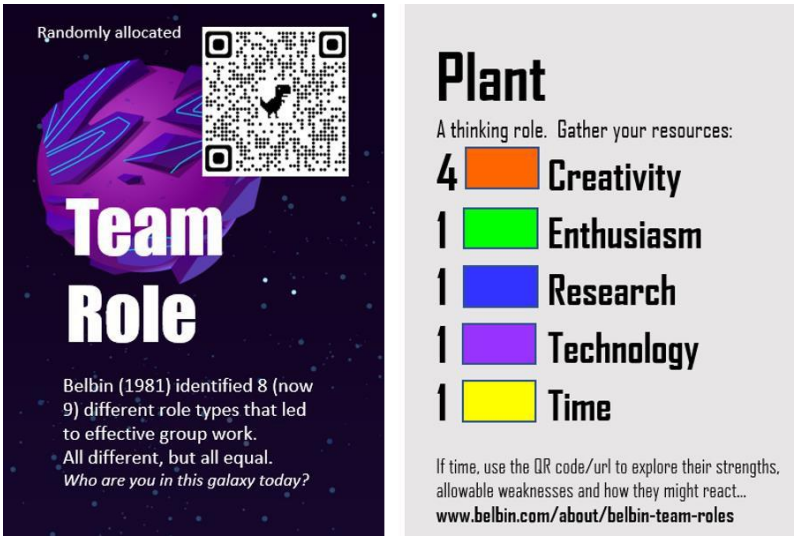

Figure A5: Example of background cards and the impact it has on your resources

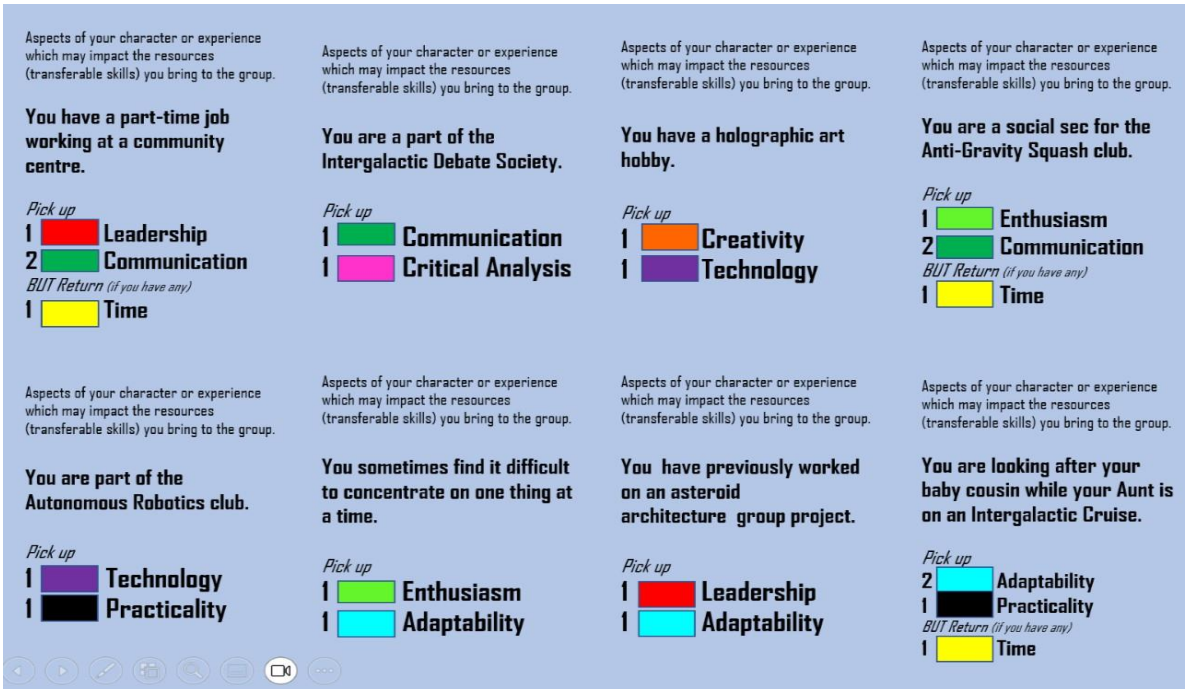

Figure A6: Example discussion cards:

Figure A7: Example of introduction card questions

What's your favourite sport?	Do you speak more than one language?	How do you like to relax?	Would you consider yourself a night owl or morning person?
Do you like rollercoasters?	What's your favourite ice cream flavour?	Can you drive?	Do you like to cook?

Figure B1: QR code to access the video instructions/explanation of the game.