IJoHS
International Journal of Healthcare Simulation

ORIGINAL RESEARCH

Using the ARCS Motivational Model to Design Interdisciplinary Virtual Reality Simulations

Janine Stockdale[1], Paul Best[2], Matt Birch[3], Paul Murphy[4], Deirdre O'Neill[1]

[1]*School of Nursing and Midwifery, Queen's University Belfast, Belfast, UK*
[2]*School of Social Sciences, Education and Social Work, Queen's University Belfast, Belfast, UK*
[3]*School of Nursing and Midwifery, Queen's University Belfast, Belfast, UK*
[4]*School of Arts, English and Languages, Queen's University Belfast, Belfast, UK*

Corresponding author: Janine Stockdale, j.stockdale@qub.ac.uk

https://ijohs.com/article/doi/10.54531/ELKJ7187

ABSTRACT

Introduction:
During the perinatal phase many women experience suboptimal mental health. Effective care however, requires an educated and connected workforce who can provide integrated mental healthcare. Achieving interdisciplinary education related to perinatal mental health is often challenging, as professionals care for women at different points in time, in varying environments and with different focuses on what is paramount. To overcome this challenge, a motivational design model was applied in the development of immersive video-based simulations, that aimed to expose healthcare professionals to interdisciplinary care planning for women whose perinatal mental health deteriorated.

Methods:
Three phases included conducting a learning needs analysis, implementing motivational tactics into the design of video-based simulations, and evaluating them for motivational and immersive impact. Students who experienced the simulations via 360° videos, flat screen and earphones versus virtual reality headsets were asked to complete a post-test measure of their level of motivation to learn and immersion into the learning experience.

Results:
The evaluation demonstrated that all students experienced an optimal motivating and immersive learning experience. No significant differences were noted in the level of motivation or perceived immersion experienced whether using the flat screen 360° videos, or the VR headsets.

Discussion:
Motivation and immersion are interconnected constructs that influence students' experience of learning via simulation. Therefore, motivational design, immersive technologies, such as 360° videos and virtual reality, can equally result in optimal motivation for interdisciplinary students to learn about shared care plans and decision-making related to perinatal mental healthcare.

What this study adds

- How simulations can be systematically enhanced by applying motivational learning design tactics
- How motivation to learn benefits from mastery and performance goals working together within a simulation design
- How 360° flat screen videos and virtual reality offer equal immersive and motivational potential

Introduction

During the perinatal period many women experience suboptimal mental health; from mild mood changes to more serious anxiety (13%) and depressive disorders (12%) [1]. In addition to the impact poor mental health can have on a woman during her pregnancy, birth and transitioning to parenthood, the evidence shows that reduced maternal mental health is also related to suboptimal infant development [2]. That is, infants whose mothers have experienced a mental health issue are also more likely to demonstrate poorer social adaptation, including emotional and behavioural problems [3]. However, Stein et al [4] argues that the adverse effects on infants and children are not inevitable and that with early and effective care the negative impact on families can be significantly minimized.

Effective care requires an educated and connected workforce who can provide a local, integrated and specialist mental healthcare service to women who become unwell [5]. To meet this requirement in Northern Ireland, the first interprofessional, postgraduate perinatal mental health module was commissioned. The educational remit was to provide a learning experience that would enable practitioners such as midwives, mental health nurses and health visitors (specialist community public healthcare professionals) to work together to design optimal and integrated care for women experiencing a deterioration in their perinatal mental health. Although interdisciplinary learning is recognized as an effective educational design for healthcare professionals caring for women and their families [6], providing interdisciplinary education is not without its challenges. For example, healthcare students bring into the learning environment their different discourses and epistemologies that can make it difficult for them to engage in interdisciplinary learning [7,8].

Research shows that interprofessional simulations can positively impact the knowledge, skills and attitudes of all disciplines [9,10], whether delivered face-to-face or via an immersive technology [11,12]. Immersion in simulation is important as it enhances the realism for the students [13] and, therefore, has the potential to influence the degree of motivation they experience. According to key theorists such as Sansone and Harackiewicz [14] and Keller [15], when students are motivated to learn, they experience an energy that leads to greater interest, persistence and effort, self-regulation and confidence to achieve. Interestingly, immersion, in terms of presence and agency, is seen to influence aspects of students' motivation to learn via simulation [16]. In Makransky and Peterson's model [16], the authors propose that presence and agency (immersion) can influence students' situational interest, intrinsic motivation, self-efficacy, embodiment, cognitive load and self-regulation. To understand how these factors and others such as curiosity, information seeking, attribution and self-worth interact to influence a student's intrinsic and extrinsic motivation to learn, Sansone and Harackiewicz [14] take our understanding beyond the motivational impact of a particular modality to a theoretical understanding of learning goals. Integrating multiple theories of motivation, the authors challenge educators to consider the role and nature of the learning goals, as a catalyst for learner motivation within a learning environment. It follows that for students to experience optimal motivation to achieve (outcome related to the goals) their motivational and self-regulatory processing (process related to achieving the goals) should be systematically and theoretically influenced. To assist educators in knowing what an optimal goal is and how to frame and set it, theories related to human motivation (achievement psychology) have been integrated into the broader practice of instructional design.

Motivational design complementing instructional design

Motivation has long been recognized as a prerequisite to learning, in that, if a person is motivated to adopt and achieve the learning goal[s], they will continue to persist and apply effort. Conversely, if they lack motivation related to the learning goal[s], optimal achievement is less likely. As evidence related specifically to the role of motivation in learning emerged, interest in how motivational theories could be systematically implemented into the educational practice of instructional design also began to grow.

Instructional design is described by Chen [17, pg 80] as a 'a set of interdependent phases including analysis of learners, contexts and goals; design of objectives, strategies and assessment tools; production of instructional materials; and evaluation of learner performance and overall instructional design effort'. As educators applied the independent phases of the instructional design process, it was noted that students may, as a result, feel motivated [18]; however, there was no ongoing systematic influence of students' motivation to learn. To address this, the discipline of motivational design as a systematic process grew as a means of enhancing instructional design. Motivational design, therefore, is a systematic process that energizes students to 'move (based on "movere", the Latin word for motivation)' towards their learning goals until they are achieved [19, pg 13]. Motivation, when carried into the learning experience on goals, aims to generate persistence and effort of the student group, towards their achievement [15]. Considering motivation affects how students approach and experience the learning goals, it follows that educators have a responsibility to not only design the instructional components, but also to implement the theories of motivation for optimal learning. To achieve this requires educators to have a working knowledge of multiple theories of motivation, for example, Goals and Goal Orientation [20], Intrinsic and Extrinsic Motivation [21], Individual and Situational Interest [22], Self-Determination Theory [23], Self-Efficacy Theory [24] and Attribution Theory [25]. Therefore, to guide educators in knowing when and how to influence students' motivation, experts in the psychology of learning developed motivational design models that can be applied as a means of motivationally enhancing the students' connection and commitment to the learning goals.

Recognizing that motivational design is complementary to instructional design, the aim of this study was to: *implement a motivational design model in the creation of immersive video-based simulations for learning about the development of interdisciplinary care planning related to deteriorating perinatal mental health.*

The study **objectives** reflected the phases associated with the model's application:

- Setting the scene, including identification of the learning goals
- Integrating motivational tactics aimed at influencing students' motivation into a class design
- Evaluating the motivational impact of the design

The applied motivational design model

In his book on Motivation and Learning Performance, Keller [15] provides a useful classification of motivational design models as a subset of instructional design. Most motivational design models are grounded in psychological theories and their systematic implementation within education. Depending on what group of psychological theories the educators apply to guide their design, these models can be classified as person-centred, environmentally centred or interaction-centred (persons interacting with their environment). A fourth group of models are referred to as omnibus models and are those where no distinction is made between instructional design and motivational design. Although successful practices can result from the implementation of an omnibus model, psychological theories are not systematically applied.

Classified as an interaction-centred model, the ARCS-V model [15] is underpinned mainly by expectancy-value theory and more recently incorporating social learning theory [26]. Considering that the learning environment is where students experience the challenge associated with the learning goals, the model from an expectancy-value position can be understood in terms of how students' 'values and innate abilities both influence and are influenced by the learning environment' [15, pg 33]. While it is beyond the remit of this paper to provide detailed insight into the ARCS-V model, a summary of what it offers educators is provided in Figure 1:

Details of the ARCS-V model and its theoretical underpinning, synthesis and design process are provided by Keller [15]; however, in summary there are two opportunities to apply the model. First, as described in this paper, to apply, in principle, the ARCS-V dimensions (Figure 2) to guide the development of new educational programmes and activities. Second, to solve specific problems related to learners' motivation with an already existing learning design (enhancement).

Although Keller's model has had mixed levels of success [27,28], it remains one of the most widely used and preferred interactionist models, demonstrating validity and reliability [29,30]. Applications include enhancement of completion rates of pharmacy undergraduates in online self-study [31], motivating netizen students to learn transferable skills and learning through gamification [26,32]. Although applying the ARCS-V model to simulation maybe advantageous, little evidence of the model's implementation to simulation is available [33].

Method

The following method describes each of the phases described in the objectives above.

Figure 1: Summary of what the ARCS-V offers educators to guide their motivational design.

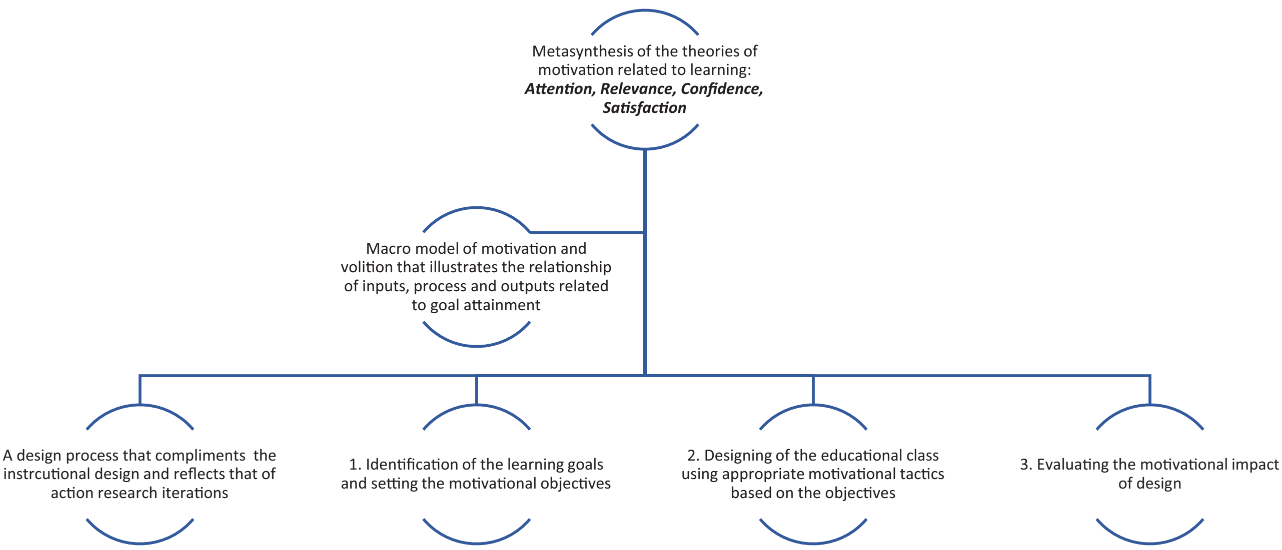
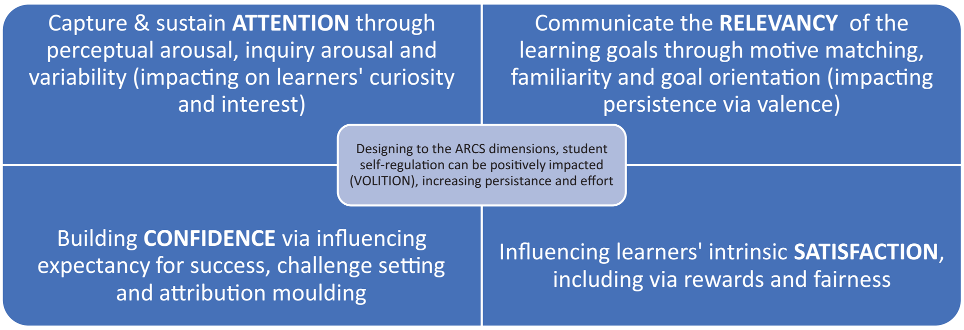


Figure 2: The dimensions of the ARCS-V meta-synthesis that guides the design process.



Phase 1 (*Learning Needs Analysis*) – as motivation is carried into the learning environment via the learning goals, a number of co-diagnostic workshops were facilitated to identify the nature and structure of the learning goals. Experts in perinatal psychiatry, psychology, obstetrics, midwifery, health visiting and family nursing were challenged to identify and agree on the key learning goal[s] associated with the module. Through collaborative discussion interdisciplinary caring emerged as a higher-order learning goal that influenced all other learning goals, including learning about common perinatal mental health conditions. Subgoals directly related to achieving interdisciplinary learning included team-working and decision-making. Determining the goals and how they relate to each other (goal structure) is important from a motivational perspective, in that, it can motivate students to create strong associations to and between the learning goals [34]. A subsequent diagnostic workshop with women who had lived experience of poor perinatal mental health, confirmed the importance of effective and safe interdisciplinary care.

Although the learning goal structure related to interdisciplinary caring was well developed through the co-design workshops, Keller [15] recommends consideration is given to what is known about the students. As the MSc module was being developed for practising midwives, health visitors and mental health nurses, it was anticipated that the students would have some shared values and previous experience related to caring for perinatal women with deteriorating mental health. Understanding the students' shared valences (audience information) can be useful when selecting motivational tactics (phase 2). It was also anticipated that the majority of the students would be on commissioned places and may not have studied for some time. It was not known if the students practised as healthcare professionals together or not. When applying the ARCS-V to existing courses and classes, an audience analysis is recommended to ascertain the students' attention readiness, perceived relevance, felt confidence and satisfaction potential. Students had not yet enrolled, so a systematic audience analysis was not possible.

Phase 2 *(Motivational Design of the Simulations and Integration of Motivational Tactics)* – the educational design team met to develop the learning experiences related to the learning goal structure, with particular emphasis on the goals related to interdisciplinary care. Team experts included those with knowledge of motivational learning design, simulation, drama, learning technology, midwifery and mental health. Through discussion it was agreed that simulated scenarios recorded as 360° videos could provide the opportunity to experience interdisciplinary caring and team-based decision-making. Two conditions taught on the course (bipolar affective disorder and obsessive-compulsive disorder) were selected as content for the scenarios, with the plan to use the video resources as part of the overall motivationally designed learning experience about interdisciplinary caring. As the team discussed the overall learning design, they aimed to apply the principles of the ARCS-V model. Table 1 provides examples of how motivational tactics were incorporated into the simulation design, including the pre-brief, simulated challenge set and post brief:

The two scenarios were recorded using a 360° camera and an additional spatial audio recorder. As described by Rizzo et al [35], 360° videos provide a panoramic view with all-round access to a 'photorealistic' view of the environment, for example, Google Street View. An advantage of 360° video footage is that it can be experienced via head-mounted display (HMD), as computer-generated virtual reality. While 360° video is a low-cost alternative to virtual reality, it has nonetheless shown equal potential in attaining 'spatial presence' (the degree to which learners feel the immersive environment is real to them). Young women capable of depicting deteriorating perinatal mental health as standardized patients were not available, so third-year drama students were coached in portraying the two women. A mental health nurse lecturer played the role of a 'healthcare professional'. Each scenario was recorded as three acts, with each act representing a stage in the overall interaction. An interdisciplinary pause and ponder simulation activity was design and implemented as outlined in Figure 3. Taking time to pause and ponder as an interdisciplinary group facilitated the intersubjectivity that occurs when people who have different conceptualizations, commence a task together, and through the process adapt, until they have a shared understanding.

The idea of designing a pause and ponder approach as a means of initiating interdisciplinary discussion and learning amongst the students was created specifically for

Table 1: Summary and examples of the applied motivational tactics to the simulation design

ARCS components	Examples of the ARCS motivational tactics incorporated into the design
Capture & sustain **Attention**	**Variability, perceptual and inquiry arousal** aims to capture and hold attention through direct sensory stimuli and the motivational role of curiosity, which is supported by variation in style and sequence. That is, perceptual arousal is activated when there are changes within the learning environment; while inquiry arousal focuses on encouraging learners to seek out information, ask questions and solve problems in order to satisfy their own curiosity. Variability, however, is associated with attention maintenance. Examples of attention tactics used to design the simulated scenarios included: – Two women's stories related to two different conditions and levels of deterioration were used to create and maintain *inquiry arousal*. – Variability across the scenarios was incorporated; for example, in one scenario, the woman was home alone (no visible support), while in the other a supportive partner was present in one of the scenes. – Sensory stimuli that related to the woman's clinical condition, such as a crying baby, were also incorporated (*perceptual arousal*)
Communicate goal **Relevancy**	To communicate relevancy, three related theoretical tactics were applied: **motive matching, goal orientation and familiarity**. Examples of the relevancy tactics included: – Connecting the current learning experience to previous experiences as clinicians were achieved by co-designing scenarios that would be *familiar* with their work experiences – A key part of the pre-brief was to link the challenge that the students were about to experience with their personal interest as healthcare professionals (*motive matching*). This open discussion created relevancy as students shared the common challenges experienced when caring for women with deteriorating mental health. – *Goal orientation* was clearly framed as a 'pause and ponder' activity (see Figure 3). This enabled simulation of the interdisciplinary discussion and skills that the students would need to visualize and imitate in their future practice (interdisciplinary, team-based decision-making) – Mastery *goal orientation* enables students to engage in the right level of difficulty and cognitive challenge, therefore, increasing their ongoing persistence, effort and development. – In addition to using positive language related to mastering interdisciplinary caring, competitive language related to performance-orientated, motive matching was minimized. Instead, those more likely to be performance-orientated were able to represent satisfy their need during the debrief session. This design decision was based on the lack of available information as to whether students were high or low in achievement motivation.
Build **Confidence**	Confidence building occurs when **the challenges are set** appropriately, and students are encouraged to have a positive **expectation for success**. Another motivational tactic is to encourage students to own their successes and failures (**attribution moulding**). Examples of confidence building tactics included: – During the pre-brief the *interdisciplinary team challenge* and *sequence* were explained and set (see Figure 3). The main challenge was to identify the women's deterioration and create an immediate care plan. As the students were also going to be experienced practitioners, the challenge was increased by placing cues around the room that provided subtle indicators of each woman's condition. For example, a Christmas tree with one decoration still in the window weeks after the season pointed to disorganized thinking as a symptom of bipolar affective disorder; as a single empty wine glass suggested alcohol consumption while breastfeeding. – *Attribution moulding* included providing the students with the opportunity as a team to create their own interdisciplinary care plan. Each team talked through their plan (student-led debrief), demonstrating their competency, which in turn positively reinforces their expectancy, and ongoing effort to master successful identification of deterioration and decision-making as an interdisciplinary team.
Influencing intrinsic **Satisfaction**	Satisfaction indicates the relationship between the students' expectations and outcomes achieved. The two main sources of satisfaction are **intrinsic motivation** (enjoyment related to taking part in the experience) and the rewarding consequences (**extrinsic rewards**). Intrinsic and extrinsic motivation can positively influence persistence, effort and learning, and off course satisfaction. **Equity** can also affect satisfaction, on the basis that if students perceive any unfairness, this will negatively affect their satisfaction with the learning experience. Examples of satisfaction tactics included: – Prior to participating in the simulated challenges, it was important that students had access to the required knowledge; otherwise, the challenge would feel unfair (*equity*). Lectures Consultant Psychiatrists and a tutorial that focused on the conditions were timetabled ahead of the simulations. – The post-simulation debrief aimed to provide motivating feedback. The student-led approach provided across-team encouragement via verbal reinforcement (stimulating *intrinsic pride as a less obvious performance goal*) for achieving the challenge set (present an interdisciplinary care plan with rationale for the team-based decision-making). The educators contributed to the feedback by recognizing related interests. – In addition to reinforcing the intrinsic satisfaction, public recognition of good performances aimed to act as an *extrinsic motivator* to the students. Effort attributions were also used to frame setbacks as challenges as opposed to evaluative threats.

this study by the educational team. As students engaged in the co-design of a care plan for the women portrayed in the videos, it was anticipated that interdisciplinarity would be achieved.

Evaluation Phase: Although ARCS-V studies can include comprehensive evaluations [36], the main purpose is to provide the educators with a descriptive view that illustrates the degree of attention, relevance, confident and satisfaction

Figure 3: Outline of the pause and ponder simulation activities within a 2-hour class.

experienced as a result of the motivational tactics applied. Through this process, educators can identify motivational problems and/or direct the next iteration in the students' learning. To explore the potential impact of immersion on student motivation, the scenarios were experienced via either 360° flat screen videos or virtual reality headsets. In summary, a comparative approach was used to evaluate the motivational impact and the degree of immersion according to the modality (scenarios experienced via 360° flat screen videos versus virtual reality headsets). Participants were randomly allocated to one of two groups:

Group A - engaged with the scenarios 360° immersive videos on virtual headsets

Group B - engaged with the scenarios as a 360° video displayed on a flat screen monitor (computer screen) with headphones.

Ethical permission was granted by the Faculty of Health and Life Science's Ethical Committee [Reference Number: MHLS 20_22].

Recruitment

Students enrolled on the Perinatal Mental Health MSc Module (n = 24) were invited to participate via their university email, 1 week prior to the timetabled class. The invitation and information sheet were sent by a member of the project team, who did not teach into the module. The Programme Lead confirmed that none of the target audience had visual or hearing impairments nor did any students report any physical limitation that would affect their involvement. Prior to taking part in the study, students were asked to complete a consent form, based on the participant information sheet (previously emailed). The students were mainly practising midwives, health visitors and mental health nurses; with two students working as emergency room nurses in a general hospital.

Randomization

Participants were randomly allocated into Group A or B using Microsoft Excel's random number generator by a member of the research team who was not involved in the module teaching. To ensure students experienced an interdisciplinary learning experience, the students were randomized to Group

Table 2: Randomization of professions to Groups A and B

Randomized to Group A	Randomized to Group B
Team 1 2 Midwives, 1 Health Visitor, 1 Mental Health Nurse	**Team 1** 1 Midwife, 1 Health Visitor, 1 Mental Health Nurse
Team 2 2 Midwives, 1 Health Visitor, 1 Mental Health Nurse	**Team 2** 2 Midwives, 1 Health Visitor, 1 ER Nurse
Team 3 2 Midwives, 1 Health Visitor, 1 Mental Health Nurse, 1 ER Nurse	**Team 3** 2 Midwives, 1 Health Visitor

Table 3: Modality for viewing according to group

Group	OCD (Time 1)	BPD
A	360° video via VR headsets	360° video via VR headsets
B	360° video via computer display screen	360° video via computer display screen

A or B according to their profession. Table 2 presents the student allocation to the groups following randomization. As there was not an equal number of students per profession, some within-group variation was unavoidable.

Group A viewed both scenarios using 360° videos via virtual reality headsets, whereas Group B viewed the same scenarios on a computer screen display that could be viewed 360° using the computer mouse (Table 3):

Data collection and analysis

A two-part self-reported measure of motivation and immersion was applied. Part A (12 items) was an adaptation of Loorbach et al's [37] Reduced Instructional Materials Motivation Survey (RIMMS). The RIMMS is a situational measure of people's reactions to instructional materials based on the four main components of the ARCS-V model (attention, relevancy, confidence, satisfaction). In addition to demonstrating validity and reliability when being developed [37], further confirmatory factor analysis demonstrated that the responses to the RIMMS retained the four-factor structure associated with the model's components (attention, relevance, confidence and satisfaction) [38]. Part B (6 items) was a valid and reliable measure of immersion and presence [39]. Additional baseline data that might explain acceptance of technology were also explored (age, previous learning by video and whether English is the participants' first language). Data was entered into SPSS v26 and checked for accuracy prior to analysis.

As the aim of an ARCS-V evaluation is to ascertain the motivational impact of the design on the group of students exposed to it, a mean score for the motivational data (Attention, Relevance, Confidence, Satisfaction) was generated. In relation to the measure of immersion and presence, descriptive statistics (Chi-square) were used to compare measures between groups (indicating the modality's potential).

Results

A total of 23 students completed the study. Participant demographics are listed in Table 4:

Motivational Results: the mean for each of the four ARCS dimensions were calculated for the study population, as indicators of how well the video-based simulations motivated students to learn about interdisciplinary care planning for two women whose perinatal mental health was deteriorating. Table 5 is a summary of the descriptive statistics related to Attention, Relevance, Confidence and Satisfaction:

To explore if motivational differences existed between those who viewed the videos in headsets versus computer display screen, a Chi-square test was conducted in relation to each of the ARCS dimensions. No significant differences were noted between groups (Attention X2 3.23, NS 0.198), (Relevance X2 2.85 NS 0.414), (Confidence X2 2.85, NS 0.239), (Satisfaction X2 5.79, NS 0.215).

Immersive Results: four items explored the degree of immersion experienced by the participating students ($n = 23$), including a comparison between groups (Table 6):

No significant differences were noted in the level of immersion experienced between the groups.

Visualizing the results

The findings related to attention, relevance, confidence and satisfaction were discussed and mapped onto an inverted U (Figure 4). Based on Yerkes Dodson Law [1908] as cited by Keller [15] the inverted U respects the curvilinear relationship between motivation and performance. For example, in relation to arousal (psychological basis for attention), a low level tends to result in low performance, yet as arousal increases, the quality and quantity of performance also increases. The effect is only beneficial to an optimal level, in that performance will deteriorate if arousal increases beyond the optimal as a result of stress. The same principle of optimization applies to relevancy, confidence and satisfaction. For example, if confidence is too low, students' performance will be hindered by their feelings of helplessness, while if it is too high, their overconfidence can result in learning gaps, in that what they actually know does not enable them to adopt the challenge set. Keller [15, pg 211]

Table 4: Demographics of students participating in the study

Variables	Frequency	Percent	Cumulative percent
Age: 21–30	4	17.4	17.4
31–40	10	43.5	60.9
41–50	9	39.1	100.0
Used Learning Videos Before: Yes	7	30.4	30.4
No	16	69.6	100.0
English First Language: Yes	20	87.0	87.0
No	3	13.0	100.0

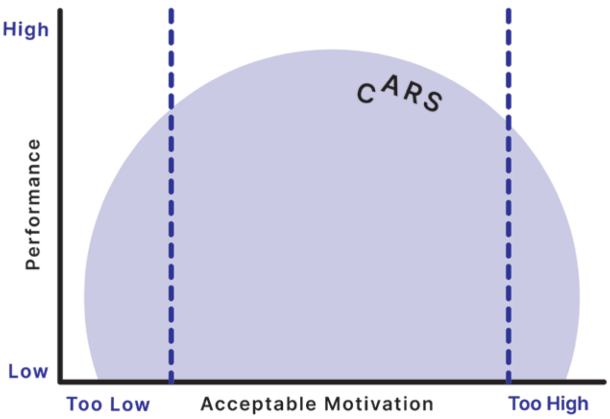
Table 5: Descriptive statistics including composite means for the four dimensions of motivation to learn

Dimensions of motivation	Min.	Max.	Mean	Standard deviation	Composite means
Attention Quality of videos held my Attention	3.00	5.00	4.56	0.6623	
Pause and Ponder held my Attention	3.00	5.00	4.52	0.6653	
Variety of the videos for care planning held my Attention	3.00	5.00	4.43	0.6623	**Attention:** 4.5
Relevance Clear P&P videos helped me learn about interdisciplinary care planning	2.00	5.00	4.30	0.8221	
Content and style conveyed the relevancy of PMH knowledge	4.00	5.00	4.86	0.3443	
The content of the videos was useful to me	3.00	5.00	4.56	0.6623	**Relevance:** 4.6
Confidence As we watched the video, I was confident I could learn	3.00	5.00	4.39	0.8387	
After watching, I was confident I could listen to similar women	3.00	5.00	4.34	0.7140	
Organization of the videos and discussion helped my confidence to lead caring in an interdisciplinary team	2.00	5.00	4.21	0.9513	**Confidence:** 4.3
Satisfaction I enjoyed working with the P&P videos; they stimulated me to keep on learning	2.00	5.00	4.60	0.7223	
I really enjoyed learning using the videos and the P&P approach	1.00	5.00	4.30	1.105	
It was a pleasure to watch and discuss such well-designed videos	2.00	5.00	4.47	0.8458	**Satisfaction:** 4.6

Table 6: Descriptive statistics for the items measuring immersion

Immersive items	Min	Max	Mean	Standard deviation	Significant group difference
I felt I was standing in her room	1.00	7.00	4.78	1.832	0.165
I think of the space as a place similar to others I have been in	2.00	7.00	5.34	1.300	0.281
During the video, I had strong sense of being in place/elsewhere	1.00	7.00	5.30	1.819	0.202
Think back on experience, think of image or somewhere visited	2.00	7.00	5.26	1.514	0.093
Times during experience, woman's room felt real	3.00	7.00	5.65	1.300	0.247
I had real sense of being in the room	4.00	7.00	5.95	1.106	0.204

Figure 4: Heuristic mapping of the ARCS components onto an inverted U.



points out that this exercise is heuristic, 'as the methods for measuring motivational levels are not sufficiently precise or stable for creating rigorous mathematical models'. Immersion was not plotted as it does not have the same inverse relationship with performance. However, both groups reported a positive level of immersion, suggesting that the motivation was related to the motivational tactics which both groups experienced equally, and not the level of immersion that was experienced differently between the groups.

In this ARCS-V application, the findings were plotted in the upper aspect of the inverted U as an acceptable level of motivation, indicating that the learning design achieved an optimal level for the groups of students. Deciding that the ARCS components should be plotted as motivationally acceptable, as opposed to too high, was based on the fact that all four components were reported at a similar level. Variation between the components would have indicated a motivational problem.

Discussion

The main purpose of an ARCS-V application is to direct the educator in embedding motivational tactics into the learning design, so that the student audience experiences optimal motivation. Designing motivating simulations is important, as students who are optimally motivated are more likely to experience intrinsic motivation to learn and therefore, feel psychologically safer. Psychological safety within simulation proposes that over-challenging students leads to stress (*over arousal so suboptimal attention*) therefore, interfering with their knowledge recall and performance [40]. Likewise, if psychological safety is achieved, students are more likely to engage in self-correcting behaviours, which is also reflective of students' volition as a result of optimal attention, relevance, confidence and satisfaction. As such, the application of a motivational design model, namely the ARCS-V model to perinatal mental health scenarios, has several benefits for interprofessional simulation and learning.

In this implementation of the ARCS-V model, the results were achieved by creating mainly a mastery-orientated group challenge. Simulation-based mastery learning (SBML) is already well documented, especially within medical education. As an omnibus approach, SBML includes key instructional design aspects, such as determining baseline diagnostics, setting scaffolded goals, engaging in supportive learning activities and ongoing assessment and feedback until the standards are met [41]. Although motivation may occur, theorists such as Barron and Harackiewicz [42] make an evidence-based argument for carefully considering the motivational impact that the types of goals set can have. For example, although SBML argues for mastery orientation, the instructional design by default includes a performance measure which students are challenged to adopt as their goals (assessments). Likewise, while the main emphasis of the ARCS tactics in this study aimed to create a mastery-orientated learning environment, it was recognized that mastery orientation alone could not meet the motivational needs of all students, especially those who were high in achievement motivation. Butler [43] therefore recommends that a multiple-goal approach is taken, where mastery goals are combined with performance goals to influence student motivation. This discussion draws out the importance of framing the learning goals both as mastery and performance goals, so most participants can feel optimally motivated.

Mastery goals are defined as those that enable the development of an ability. Performance goals are those that enable the ability to be demonstrated. According to Molden and Dweck [44] performance goals are motivated by a desire to 'approach success' and/or 'avoid failure'. This subtle difference is critical when it comes to adding meaning to how learning is experienced. For example, students who are motivated to approach a performance goal (demonstrate their competency), when successful, can enjoy, value the task and in doing so experience the benefits of intrinsic motivation. In turn, their intrinsic motivation enables them to maintain their mastery-orientated pattern, even if faced with a performance failure. Exposed to these motivational influences, student groups who adopt mastery and performance-orientated goals alongside each other are, therefore, more likely to learn through effort while remaining psychologically safe. However, when students approach a challenge mainly from a motivational basis of wanting to avoid failure (performance avoidance-goal), they become vulnerable, risk-avoidant, defensive and have low intrinsic interest and performance [44]. It is because of this possibility that mastery-orientated learning goals tend to take centre-stage when educators are designing new learning experiences; yet for students high in achievement motivation, an opportunity to demonstrate their competency as an approach performance goal is equally important.

In this study, the simulated activity was being designed for a new student cohort; therefore, the aim of the design team was to emphasize mastery orientation, supported by a less obvious performance orientation. Taking a multiple-goal orientation where strong mastery goals are paired with less predominant performance goals [44] is a good starting point when students' motivation is unknown. For example, the pause and ponder aspect of the learning experience was designed as a stronger group-based, mastery goal (pause and ponder) combined with a weaker performance-approach goal (student-led debriefing, enabling those high in achievement motivation to demonstrate their ability and generate intrinsic pride). The presence of the performance goal opportunity within the mastery-orientated context was further managed by designing the group-based challenge. Underpinned by Datt and Aspden when applying the ARCS model to skill development in netizens, group-based activity can engage students as natural collaborators, who enjoy learning through co-constructed social learning experiences [26].

In summary, the findings confirmed that for this group of students, the applied motivational tactics guided the goal structuring and resulted in optimal motivation to learn about perinatal mental health and how to provide interdisciplinary care. It follows that the pragmatism of Keller's ARCS-V model [15] can enable educators to design optimally simulating learning activities, even when the motivational response of the students to simulated learning is not previously known.

Limitations

The limitations of motivational design are well documented [15] and include the time and commitment required to apply the systematic approach in iterations. Motivation to learn, as already pointed out, is situational in that it is carried into the learning environment through the way in which the learning goals are designed and framed. The utility value of any design is therefore limited to the context and would have to be motivationally adapted for other applications. For the same reason, the sample size is limited to the number of students exposed to the timetabled education; meaning that powered differences between those randomized to VR (virtual reality) versus 360° videos could not be fully evaluated. Additionally, unequal numbers of the different professions were randomized to the student groups. This may have impacted upon the results although all students did experience working with another profession.

In this initial study, the students' volition (ongoing self-regulation) was not investigated; therefore, it was not possible to assess if students' intrinsic motivation continued to drive and energize their learning about interdisciplinary care planning. Nonetheless, this preliminary evidence demonstrates that motivational design can influence students' motivation to learn via immersive video-based, simulations and therefore, the goal structure associated with a group-based pause and ponder activity is a useful design for creating simulations that aimed to let students experience interdisciplinary care planning related to perinatal mental health.

Conclusion

Designing interdisciplinary simulations related to interdisciplinary perinatal mental healthcare is known to be challenging. Yet, this study supported the concept that an interdisciplinary learning simulation about perinatal mental health that was designed using the ARCS-V motivational design model [15] can be optimally motivating. Whether viewed via flat screen and earphones or virtual reality headsets, the recorded scenarios created optimal attention, relevance, confidence and satisfaction for the student groups. Although the results are situational, the potential for further research into the use of the ARCS-V model related to simulation design and evaluation exists.

Declarations

Authors' contributions

None declared.

Funding

None declared.

Availability of data and materials

None declared.

Ethics approval and consent to participate

None declared.

Competing interests

None declared.

References

1. Regulation and Quality Improvement Authority (RQIA). Review of Perinatal Mental Health Services in Northern Ireland. 2017. Accessed online 27th January 2020: https://www.rqia.org.uk/RQIA/files/28/28f4ee85-a5e9-4004-b922-525bc41ae56d.pdf
2. Lewis AJ, Austin E, Knapp R, Vaiano T, Galbally M. Perinatal Maternal Mental Health, Fetal Programming and Child Development. Healthcare, 2015;3(4): 1212–1227
3. Harden BJ, Panlilio C, Morrison C. et al. (2017) Emotion regulation of preschool children in foster care: The influence of maternal depression and parenting. Journal of Child and Family Studies, 26(4), 1124–1134. https://doi.org/10.1007/s10826-016-0636-x
4. Stein A, Pearson RM, Goodman SH, Rapa E, Rahman A, McCallum M, Howard L, Pariante C (2014) Effects of Perinatal Mental Health Disorders on the Fetus and Child. The Lancet 384:9956, 1723–1724. htpps://doi.org/10.1016/S0140-6736 (14) 61277-0.
5. Legere LE, Wallace K, Bowen A, McQueen K, Montgomery P, Evans M. Approaches to health-care provider education and professional development in perinatal depression: a systematic review. BMC Pregnancy Childbirth. 2017;24;17(1):239. https://doi.org/10.1186/s12884-017-1431-4. PMID: 28738855; PMCID: PMC5525243
6. Howard LM, Khalifeh H. Perinatal mental health: a review of progress and challenges. World Psychiatry 2020;19(3):313–327. https://doi.org/10.1002/wps.20769
7. Ashby I, Exter M. Designing for interdisciplinarity in higher education: considerations for instructional designers. Tech Trends 2019;63: 202–208. 27th Nov 2018.
8. Grace S. Models of interprofessional education for healthcare students: a scoping review. Journal of Interprofessional Care (J Interprof Care), Sep-Oct 2021;35(5):771–783. (13p)
9. Guraya YS, Barr H. The effectiveness of interprofessional education in healthcare: a systematic review and meta-analysis. The Kaohsiung Journal of Medical Sciences. 2018;34(3), 160–165
10. Attoe C, Lavelle M, Sherwali S, Rimes K, Jabur Z. "Student interprofessional mental health simulation (SIMHS): evaluating the impact on medical and nursing students, and clinical psychology trainees", The Journal of Mental Health Training, Education, and Practice. 2019;15(1):46
11. Wood YI, Zegwaard KE, Fox-Turnbull W. (2020) Conventional, remote, virtual and simulated work-integrated learning: A meta-analysis of existing practice. International Journal of Work-Integrated Learning, Special Issue. 21(4), 331–354
12. Atuel HR, Kintzle S. Comparing the Training Effectiveness of Virtual Reality and Role Play Among Future Mental Health Providers. Psychological Trauma: Theory, Research, Practice, and Policy. Advance online publication. http://dx.doi.org/10.1037/tra0000997
13. Lan YJ. Immersion, interaction and experience-oriented learning: Bringing virtual reality into FL learning. Language Learning & Technology, 2020;24(1):1–15, http://hdl.handle.net/10125/44704
14. Sansone C, Harackiewicz JM. Intrinsic and extrinsic motivation: the search for optimal motivation and performance. 2000. San Diego, USA: Published by Academic Press.
15. Keller JM. Motivational design for learning and performance. 2010 New York: Published by Springer.
16. Makransky G, Peterson GB. The Cognitive Affective Model of Immersive Learning (CAMIL): a theoretical research-based model of learning in immersive virtual reality. Educational Psychology Review 2021;33:937–958. https://doi.org/10.1007/s10648-020-09586-2
17. Chen I. Instructional design methodologies. In: Instructional design concepts and methodologies, tools and applications. 2011;80–94. Online Book: https://doi.org/10.4018/978-1-60960-503-2.ch108
18. Brown AH, Green TD. The essentials of instructional design: connecting fundamental principles with process and practice. 4th ed. 2019. New York: Published by Routledge.
19. Koh C. Motivation, leadership and curriculum design: engaging the net generation and 21st century learners. 2015. New York, London: Springer Singapore.

20. Latham GP, Locke EA. "Goal setting—a motivational technique that works." Organizational Dynamics 1984;8(2) (1979): 68–80. https://doi.org/10.1016/0090-2616(79)90032-9.
21. Ryan RM, Deci EL. Intrinsic and Extrinsic Motivations: Classic definitions and new directions. Contemporary Educational Psychology 2000;1(25):54–67. https://doi.org/10.1006/ceps.1999.1020
22. Hidi S, Renninger KA. The four-phase model of interest development. Educational Psychologist. 2006;41(2):111–127.
23. Deci EL, Ryan RM. 1985. Intrinsic motivation and self-determination in human behavior. New York: Plenum.
24. Bandura A. 1977. Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191
25. Weiner B. An attributional theory of achievement motivation and emotion. Psychological Review. 1985;92(4):548–573.
26. Datt A, Aspden T. Motivating learning and skills development in netizens. In Koh Motivation, Leadership & Curriculum Design. 2015;63–74. Singapore: Springer.
27. Dincer S. The effects of materials based on ARCS Model on motivation: a meta-analysis. ISSN: 1305-3515 / 1305-3515Sayfa Aralığı: 2020;1016–1042. Metin Dili:İngilizce https://doi.org/10.17051/ilkonline.2020.695847
28. Goksu I, Bolat YI. Does the ARCS motivational model affect students' achievement and motivation? Review of Education. 2021;9(1):27–52. https://doi.org/10.1002/rev3.3231
29. Astleitner H, Hufnagl M. The effects of situation-outcome-expectancies and of ARCS-strategies on self-regulated learning with web-lectures. Journal of Educational Multimedia and Hypermedia. 2003;12(4), ISSN 1055-8896
30. Chang Y-S, Hu KJ, Chiang C-W, Lugmayre A. Applying mobile Augmented Reality (AR) to teach interior design students in layout plans: evaluation of learning effectiveness based on the ARCS model of learning motivation theory. Sensors. 2020;20(1);105. https://doi.org/10.3390/s20010105
31. Pittenger A, Doering A. Influence of motivational design on completion rates in online self-study pharmacy-content courses. Distance Education. 2010;31(3), 275–293. https://doi.org/10.1080/01587919.2010.513953
32. Woolwine S, Romp C, Jackson B. Game on - evaluating the impact of gamification in nursing orientation on motivation and knowledge retention. Journal for Nurses in Professional Development. Oct 2019:35(5):255–260. https://doi.org/10.1097/NND.0000000000000570
33. Du Pont JS. Nursing faculty motivation to use high-fidelity simulation: An application of Keller's ARCS model. 2012. Capella University ProQuest Dissertations Publishing, 3547010.
34. Shah JY, Kruglanski AW. (2000) Structure and substance of intrinsic motivation. In: Sansone C, Harackiewicz JM. (2000) Intrinsic and extrinsic motivation: the search for optimal motivation and performance. San Diego, USA: Academic Press.
35. Rizzo AA, Ghahremani K, Pryor L, Gardner S. Immersive 360-degree panoramic video environments: research on creating useful and usable applications. Human-Computer Interaction: Theory And Practice. 2003;1:1233–1237.
36. Stockdale J, Sinclair M, Kernohan WG, Keller JM, Dunwoody L, Cunningham JB, Lawther L, Weir P. Feasibility study to test Designer Breastfeeding: a randomised controlled trial. Evidence Based Midwifery. 2008;6(3):76–82
37. Loorbach N, Peters O, Karreman J, Steehouder M. Validation of the Instructional Materials Motivation Survey (IMMS) in a self-directed instructional setting aimed at working with technology. Br J Educ Technol. 2015;46(1):204–218.
38. Wang S, Christensen C, Yuning Xu Wei Cui, Tong R, Shear L. Measuring Chinese middle school students' motivation using the Reduced Instructional Materials Motivation Survey (RIMMS): a validation study in the adaptive learning setting. Frontiers in Education. 2020;11:1803. https://doi.org/10.3389/fpsyg.2020.01803
39. Slater M, Usoh M, Steed A. 1994. Depth of Presence in Virtual Environments. Presence: Teleoperators and Virtual Environments, MIT Press, 1994;3(2):130–144.
40. Turner S, Harder N. Psychological safe environment: a concept analysis. Clinical Simulations in Nursing. May 2018;18:47–55.
41. McGaghie WC, Issenberg SB, Barsuk JH, Wayne DB. (2014) A critical review of simulation-based mastery learning with translational outcomes. Medical Education. April 2014;48(4):375–385. doi:10.1111/medu.12391
42. Barron KE, Harackiewicz JM. Achievement goals and optimal motivation: a multiple goals approach, 229–253. In: Sansone C, Harackiewicz JM. Intrinsic and extrinsic motivation: the search for optimal motivation and performance. 2000. San Diego USA: Published by Academic Press.
43. Butler R. 2000. What learners want to know: the role of achievement goals in shaping information seeking, learning and interest, 161–194. In: Sansone C, Harackiewicz JM. Intrinsic and extrinsic motivation: the search for optimal motivation and performance. 2000. San Diego, USA: Published by Academic Press.
44. Molden DC, Dweck C. Meaning and motivation, 131–159. In: Sansone C, Harackiewicz JM. Intrinsic and extrinsic motivation: the search for optimal motivation and performance. 2000. San Diego, USA: Published by Academic Press.