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| Question | |
| **Should gamified learning vs. non-gamified learning be used for life support training?** | |
| **Population:** | Learners training in basic or advanced life support |
| **Intervention:** | Instruction using gamified learning (use of game-like elements in the context of training (e.g. point systems, intergroup competition, leaderboards, scaffolded learning with increasing challenge, ‘medals’ or ‘badges’)) |
| **Comparison:** | Compared to traditional instruction or other forms of non-gamified learning |
| **Main outcomes:** | Skill -- overall CPR performance; Skill -- CPR rate and depth; Knowledge -- NRP; Knowledge -- BLS and ALS; Skill -- ALS scenario score; Skill -- NRP scenario score; Skill -- time to PPV in neonatal resuscitation simulation; Skill -- pediatric epinephrine dosing; Knowledge -- pediatric epinephrine dosing; Attitude -- affective responses; |
| **Setting:** | Life support education for healthcare providers/trainees and laypersons |
| **Perspective:** |  |
| **Background:** | Increased familiarity and ease with technology and digital media are features of younger and upcoming generations. More effective teaching strategies for these learners may include a greater degree of stimulation and engagement using active participation with and alongside peers. Gamification refers to the use of game-like elements, usually in a digital format, to encourage interactive and intuitive participation by learners. Some preliminary studies have found that gamified learning (GL) results in improved knowledge and skill during CPR training, either alone or used as pre-training to a standard life support course; other studies have found no significant difference. |
| **Conflict of interests:** | none |

# Assessment

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| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ● Probably yes ○ Yes ○ Varies ○ Don't know | Increased familiarity and ease with technology and digital media are features of younger and upcoming generations. More effective teaching strategies for these learners should include a greater degree of stimulation and engagement using active participation with and alongside peers. Gamification refers to the use of game-like elements (competition, point systems, scaffolded levels of difficulty, leaderboards) to encourage interactive and intuitive participation by learners. | While some examples in the review include simple game formats (e.g. board games, card games), the majority of examples include technology-dependent methods (e.g. video, computer, or smartphone based). |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ● Small ○ Moderate ○ Large ○ Varies ○ Don't know | Skill -- CPR overall performance  We included four randomized controlled trials (RCTs) with 900 intervention subjects and 789 controls. One observational study of 92 subjects was included. One RCT in nursing students using an online competitive platform for CPR performance found improved scores compared with non-users (p<0.05).1 Two RCTs in pediatric healthcare providers used a leaderboard to monitor competition in CPR performance during refresher training sessions; one single center study found significantly better performance in leaderboard group (p<0.001)2; the other multicenter RCT found no effect.3 One RCT in laypeople using team competition in CPR performance during training found better CPR performance in the competition group than controls (p<0.05).4  One observational study of laypeople using a screen-based competition at CPR performance found improved performance 6 months post training (score 23% vs. 16%, p<0.05).5  Skill -- Chest compression rate and depth  We included one observational study of 65 high school students participating in a CPR "tournament" during Basic Life Support (BLS) training via a screen-based interface. Immediately post training, chest compression (CC) depth (45 vs 31 mm, p<0.01) and CC rate (111 vs 94, p<0.01) were improved from baseline. At 3 months, depth and rate remained improved over baseline but no different than immediately post training.6  Knowledge -- NRP  We included two observational studies of healthcare providers. One study of a board game using Neonatal Resuscitation Program (NRP) knowledge showed improved scores after playing (61% vs 49%, p<0.001).7 One study of a screen-based point system-based game in NRP led to higher scores 6 months post training (p<0.001) but no difference immediately post training.8  Knowledge -- ALS  We included two RCTs in healthcare providers with 145 intervention subjects and 144 controls. One RCT using a phone-based team game involving identifying keywords found greater improvement in scores on a multiple choice question test following life support training (p<0.05).9 One RCT using a smartphone-based game involving Advance Life Support (ALS) scenarios with a point system during and before an ALS course found higher scores on an ALS algorithm test among game users (17 vs 16, p=0.01).10  Skill -- ALS scenario score  We included one RCT in healthcare providers with 53 intervention subjects and 52 controls. Intervention subjects used a smartphone-based game involving ALS scenarios before and during an ALS course. Scores were not significantly different between groups (79% vs 66%, p=0.09).10  Skill -- NRP scenario score  One observational study of using an online gaming portal involving NRP training found improved scores following game use (p<0.001).11  Skill -- time to PPV in NRP scenario  One observational study of using an online gaming portal involving NRP training found faster time to positive pressure ventilation in a neonatal scenario (p=0.04).11  Skill -- pediatric epinephrine dosing  We included one observational study of nurses using a leaderboard during a study period of repeated practice at preparing weight-based epinephrine dosing. Over the study period, average time to dose prep decreased by 27 seconds (p=0.02); the proportion of learners completing the task in < 2 minutes increased from 23% to 59% (p=0.03).12  Knowledge -- pediatric epinephrine dosing  We included one observational study of nurses using a leaderboard during a study period of repeated practiced at preparing weight-based epinephrine dosing. Over the study period, the proportion of learners knowing the correct concentration of epi increased from 19% to 71% (p<0.001).12  Affective responses  One RCT using a smartphone-based game in ALS training led to better self-reported confidence among users.10 One study of a card game to enhance NRP knowledge had high levels of perceived usefulness among surveyed learners post-study.13 | No studies of clinical outcomes in patients |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Trivial ○ Small ○ Moderate ○ Large ○ Varies ○ Don't know | No studies found negative effects on learner outcomes. | No studies examined the impact of GL on stress or cognitive load of learners; it seems intuitive that these constructs may be positively exploited to enhance engagement and learning if GL is effective. |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| ● Very low ○ Low ○ Moderate ○ High ○ No included studies | The quality of evidence was very low across all outcomes, and downgraded for risk of bias, inconsistency, indirectness, and imprecision. |  |
| Values Is there important uncertainty about or variability in how much people value the main outcomes? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability ● Possibly important uncertainty or variability ○ Probably no important uncertainty or variability ○ No important uncertainty or variability | Two studies reported favorable affective responses following training from learners.10, 13 |  |
| Balance of effects Does the balance between desirable and undesirable effects favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ● Probably favors the intervention ○ Favors the intervention ○ Varies ○ Don't know | The majority of studies found a positive impact of GL on learner outcomes; while some studies found no effect on some domains, there were no published studies demonstrating a negative outcome on learners. | The value of GL should also be examined from the perspective of instructors and designers of learner curricula. |
| Resources required How large are the resource requirements (costs)?" | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs ○ Moderate costs ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ● Don't know | No published studies examined cost effectiveness of GL. | Most GL elements used either video-, computer-, virtual reality-, or smartphone-based programs as platforms for GL. There were no studies that specifically described the cost or necessary resources for such methods. |
| Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High ● No included studies | No published studies examined resource utilization associated with GL. |  |
| Cost effectiveness Does the cost-effectiveness of the intervention favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ● No included studies | No published studies examined cost effectiveness of GL. |  |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies ● Don't know | No published studies. | Access to digital technology platforms is likely to be a potentially limiting factor in resource-limited settings. Smartphone-based platforms may be more available in such settings. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know | Two studies reported favorable affective responses following training from learners.10, 13 |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes ● Varies ○ Don't know | While most studies described the creation of the GL elements used in the research, there were no examples of studies determining how to feasibly implement the GL in other settings or with other groups of instructors or learners. | It is likely that different GL elements (e.g., technology dependent) will have greater demands in terms of implementation and instructor training. |

# Summary of judgements

|  | **Judgement** | | | | | | |
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| **Problem** | No | Probably no | **Probably yes** | Yes |  | Varies | Don't know |
| **Desirable Effects** | Trivial | **Small** | Moderate | Large |  | Varies | Don't know |
| **Undesirable Effects** | **Trivial** | Small | Moderate | Large |  | Varies | Don't know |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | **Possibly important uncertainty or variability** | Probably no important uncertainty or variability | No important uncertainty or variability |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | **Probably favors the intervention** | Favors the intervention | Varies | Don't know |
| **Resources required** | Large costs | Moderate costs | Negligible costs and savings | Moderate savings | Large savings | Varies | **Don't know** |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | **No included studies** |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | **No included studies** |
| **Equity** | Reduced | Probably reduced | Probably no impact | Probably increased | Increased | Varies | **Don't know** |
| **Acceptability** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |
| **Feasibility** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |

# Type of recommendation

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| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | **Conditional recommendation for the intervention** | Strong recommendation for the intervention |
| ○ | ○ | ○ | **●** | ○ |

# Conclusions

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| Recommendation |
| The Task force suggests the use of Gamified Learning (GL) to be considered as a component of resuscitation training for all types of basic and advanced life support courses (weak recommendation, very low certainty of evidence). |

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| Justification |
| **Overall justification:** GL was associated with improved learning outcomes in at least one domain (skill, knowledge, attitude) in all studies included in the review.  **Detailed justification**  *Desirable Effects:* All of the 13 studies in this review found a positive impact on one or more learning outcome domain (skill, knowledge, attitude).  *Undesirable Effects:* No specific undesirable effects among learners were found. |

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| Subgroup considerations |
| 11 of 13 studies used technology-dependent platforms (video, computer, smartphone) to deliver GL elements to learners.1-6, 8-12 There is insufficient evidence to compare these GL elements to other less technology enhanced methods (e.g. board games).  Only 2 studies examined outcomes in laypeople (high school students).5, 6 |

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| Implementation considerations |
| The feasibility and ease of implementing elements of GL will likely vary greatly depending on the method(s) used and the level of technology required to deliver the content.  More research is needed to clarify the instructor training needs for GL implementation and the generalizability of access and use of GL in a consistent and reproducible manner. |

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| Monitoring and evaluation |
| NA |

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| Research priorities |
| -- more consistent definitions of 'gamification' across research studies (e.g. use of video-based content delivery alone does not necessarily constitute a 'game' although his term is frequently used to describe such training elements)  -- studies on dissemination of GL elements and platforms to varied learner groups and settings  -- studies on cost and time requirements for implementation of GL  -- association between GL elements and differences in stress and/or cognitive load  -- impact on care delivery and/or patient outcomes |

# References Summary

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