

Table S1

Primary author (year of publication)	Country	Research method	Research paradigm	Data sources	Sample size	Educational context	Educational Stage	Learning outcome	Type of GPBL
Callaghan (2016)	Australia	Mixed	3	Observations, questionnaires, texts, artifacts	168	Out-of-class	Secondary School	A, E	3
Gabriele et al. (2017)	Italy	Quantitative	1	Tests, questionnaires	136	In-class	University	E	3
Díaz-Lauzurica et al. (2019)	Spain	Qualitative	3	Observations, interviews, texts	8	In-class	Secondary School	A, B, E, F	3
Ke et al. (2019)	China	Mixed	4	Tests, interviews,	10	Out-of-class	Secondary School	C, D, E, F	3

				observations					
Ke et al. (2019)	China	Mixed	4	Tests,  interviews,  observations	10	Out-of-class	Secondary  School	C, D, E , F	3
Hewett et al. (2020)	United States	Qualitative	3	Observations,  interviews,  artifacts	13	Out-of-class	Secondary  School	A, C	3
Punia et al. (2020)	India	Quantitative	2	Artifacts,  questionnaires	240	In-class	University	B	3
Wang (2020)	China	Mixed	2	Questionnaire,  interviews,  artifacts,  tests	186	In-class	Primary  School	D, E, F	3

Kapralos et al. (2015)	Canada	Mixed	3	Questionnaires, interviews	40	In-class	University	E	4
Gestwicki et al (2016)	United States	Qualitative	3	Interviews,  observations,  texts	-	Out-of-class	University	-	4
Prigmore et al. (2016)	United Kingdom	Qualitative	3	Interviews	3	Out-of-class	University	-	4
Baran et al. (2018)	Turkey	Mixed	2	Tests,  questionnaires,  interviews	34	In-class	Secondary  School	D, E	4
Costa et al. (2018)	Portugal	Mixed	3	Questionnaires	58	In-class	Primary  School,  Secondary	B	4

							school		
Topalli et al. (2018)	Turkey	Quantitative	2	Tests	395	In-class	University	D	4
Arnab et al. (2019)	United Kingdom	Quantitative	3	Questionnaires, observations, texts	122	In-class	University	A, E	4
Gaeta et al. (2019)	Spain, Austria, UK	Quantitative	4	Questionnaires	308	In-class	Primary school, Secondary school	A, B, E	4
Romero et al. (2019)	Malaysia	Mixed	3	Questionnaires	18	In-class	University	-	4
Engström et al. (2020)	Sweden, China,	Mixed	2	Observations, questionnaires,	34	In-class	University	-	4

	Denmark			artifacts					
Osman et al. (2020)	Malaysia	Quantitative	2	Tests,  questionnaires,  interviews	138	In-class	Secondary  Schools	A, C, D	4
Francese et al. (2015)	Italy	Mixed	3	Observations,  questionnaires, texts	55	In-class	University	B, E	1
Warin et al. (2015)	France	Mixed	4	Observations,  questionnaires,  interviews,  texts	41	In-class	University	C, E	2
de-Juan et al. (2016)	Spain	Mixed	1	Tests,  questionnaires	27	In-class	University	D, E	1

Wu et al. (2016)	United States	Mixed	3	Observations, questionnaires	8	In-class	University	A, D, E, F	2
Chua et al. (2017)	Malaysia	Quantitative	3	Questionnaires	105	In-class	University	A, C, E, F	1
Shih et al. (2017)	China	Mixed	3	Questionnaires, observations, interviews	20	Out-of-class	Primary Schools	A, D, E	1, 2
Gelonch-Bosch et al. (2019)	Spain	Mixed	3	Questionnaires, observations	-	In-class	University	E	1
Mantawy et al. (2019)	United States	Mixed	3	Questionnaires, artifacts	12	In-class	University	A, C, E	1
Isabelle (2020)	Canada	Mixed	1	Observations, questionnaires,	269	In-class	University	A, C, D, E, F	1

				artifacts					
Yoon et al. (2015)	Korea	Mixed	1	Questionnaires,  artifacts	13	In-class	University	A, D, E	1, 3
Altanis et al. (2018)	Greece	Mixed	1	Questionnaires,  observations	22	In-class	Secondary  Schools	B, C, E	3, 4
Fuster-Guilló et al. (2019)	Spain	Quantitative	3	Questionnaires,  observations,  artifacts	140	In-class	University	B, E	1, 3
Rajkovic et al. (2019)	Serbia	qualitative	4	Interviews,  artifacts	58	In-class	University	A, F	3, 4
Rodríguez-Oroz et al. (2019)	Chile	Quantitative	4	Tests,  questionnaires	16	In-class	University	D,E	3, 4

Alden et al. (2020)	Italy	Mixed	4	Questionnaires,  observations,  interviews	10	In-class	Primary  Schools	B, E	3, 4
Hernández Gándara et al. (2020)	Spain	Mixed	4	Questionnaires,  observations,  Interviews,  texts	44	In-class	University	E	2, 4

#### Research paradigm

- 1- Single-group pre-post-test design
- 2- inter-group experiments
- 3- Case study
- 4- Design-based study

#### Learning outcomes

- A-Learning and innovation skills
- B- Information, media and technology skills
- C-life and career skills



D-Subject knowledge and achievement

E-Learning experience and motivation

F-Meta-cognition and independent learning skills

Type of GPBL

1- Gamifying PBL procedure and activity

2- Gamifying PBL content and essence

3- Introduce ready-made educational/serious games in PBL

4- Using game making as the targeted product of PBL