ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

A Pilot Study Investigating the Impact of Intensive Gaming on the Performance of Surgically-Naïve Medical Students with a Cutting-Edge Robotic Simulator

antonio.gangemi3@unibo.it

Antonio Gangemi, MD, FACS, FASMBS[1]; Alessio C. Romanelli, BSc[2];
Giorgia Radi, MD[3]; Dario Rosini, MD[3]; Kerry J. Rhoden, PhD[1]; Matteo Cescon, MD, PhD[1]; Elisabetta Poluzzi, PhD[1]; Marco Seri, MD[1];
[1]University of Bologna - IRCCS Sant'Orsola-Malpighi; [2]Department of Medical and Surgical Sciences – University of Bologna; [3]IRCCS Sant'Orsola-Malpighi

linkedin.com/in/alessio-romanelli
linkedin.com/in/antonio-gangemi

Background

The applications of robotic-assisted surgery (RAS) continue to grow, and with them, the need for robotic training. **Robotic simulators** (RS) allow training in a **virtual and augmented reality environment** without exposing the patient to the inherent risk of being operated on by an inexperienced surgeon. The cost of RS remains significant, and thus their use must be **optimized**. **Videogaming** (VG) is known to **improve** hand-eye coordination and spatial awareness, mirroring those skills required to perform surgical tasks on the RS. Moreover, the integration of video gaming principles into surgical training represents an **emerging**, **innovative** approach to optimize skill acquisition for robotic surgery, leveraging cutting-edge advancements in human-computer interaction and simulation technologies.

Hypothesis

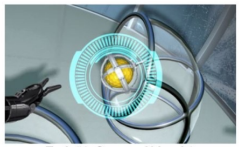
We hypothesized that trainees with a history of VG would demonstrate superior performance on a RS, due to the **transfer** of gaming-related visuomotor **skills**, cognitive and technical **abilities**.

Materials and Methods

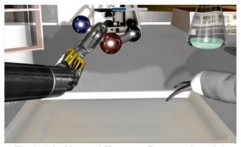
Sixty-two medical students were surveyed on their **VG** history and **experience** with sport and musical activities and then asked to complete 4 exercises (Camera 0° level 1, Use of Energy source 1, Roller Coaster 2, Vertical Defect Suturing) on the **RobotiX Mentor**™ Simulator (SurgicalScience) after playing **two mobile-phone games a minimum of 30 minutes/day** (Temple Run-Imangi Studios, NC, USA, and Piano Tiles 2™-Cheetah Mobile, Beijing, CN) for one week. Task completion time, success and error rates, and motion efficiency were assessed. This methodology highlights a novel fusion of **recreational gaming tools with high-fidelity medical simulation**, showcasing the potential of integrating accessible, gamified platforms with professional training technologies.



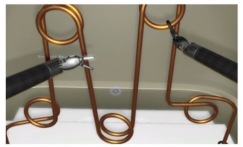
RobotiX Mentor Simulator (Surgical Science)



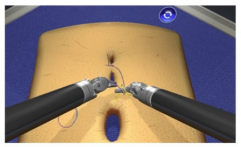
Task #1: Camera 0° level 1



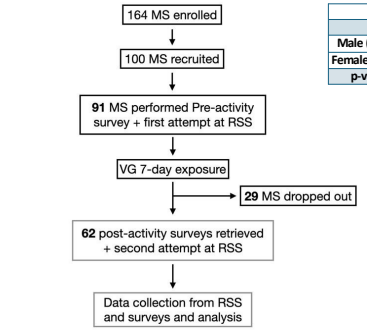
Task #2: Use of Energy Source level 1



Task #3: Roller Coaster level 2



Task #4: Vertical Defect Suturing



MS: medical students; RSS: robotic surgical simulator; VG: video gaming;

	Camera 0° level 1	Use of Energy source level 1			Vertical Defect Suturing
	IC	EAOM	SR	TT	ANP
Male (mean)	-25,55	-16,62	+10,34	-92,66	+1,793
Female (mean)	-2,364	-10,88	+4,727	-124,7	+5,727
p-value	0,0046	0,0142	0,0042	0,0109	<0,0001

Table 1 – Gender comparison (all improved metrics)
IC: instrument collisions; EAOM: energy applied outside the marks; SR: success rate; TT: total time; ME: misapplied energy; ANP: accurate needle passages;

	Camera 0° level 1		Use of Energy source level 1	
	TT	MT	TT	Accuracy
Tot. Mean	-59,85±10,49	-2,863±0,5441	-104,9±26,63	+8,348±2,887
p-value	<0,0001	<0,0001	0,0001	0,005

Table 2 – Selected improved metrics
TT: total time; MT: missed targets;

	Camera 0° level 1	Use of Energy source level 1	
	IC	EAOM	TT
Yes (mean)	-9,4	-16,94	-73,69
No (mean)	-18,15	-9,815	-156,4
p-value	0,0015	0,0322	0,0197

Table 3 – Self-reported tech-savviness (all improved metrics)
IC: instrument collisions; EAOM: energy applied outside the marks; TT: total time;

Results

Trainees with a history of extensive VG experience exhibited significantly better performance, completing tasks faster and with fewer errors at the completion of the study. In particular, students performed better in the Camera 0° level 1 task with a **reduction total time** of execution (-59,85±10,49 [s], p<0,0001) and **missed targets** (-2,863±0,5441, p<0,0001). Furthermore, improvement was noted in the Use of Energy source 1 exercise, with **enhanced accuracy** (+8,348±2,887, p=0,005) and **drop in the total time** to complete the task (-104,9±26,63 [s], p=0,0001). These findings underline the value of using next-generation training methods that adopt accessible tools, **overcoming the limitations of conventional surgical education.**

Conclusions

Our findings suggest a positive relationship between VG and RS performance, indicating that **VG may enhance certain cognitive and motor skills relevant to RAS**. This positive association could allow the design of **tailored training curricula** or to complement them with VG. By integrating VG into training programs, we could potentially **reduce the time and cost** required to achieve surgical proficiency, while also making the process **more engaging for trainees**. However, as with any novel approach, further research is needed: future studies should aim to confirm these findings, investigate the long-term **impact of gaming** on surgical skills, and explore the role of other dexterity-enhancing activities. The study opens the door to the development of training programs that utilize next-generation RS to gain surgical expertise. By bridging the gap between engaging technologies and training, this approach sets a precedent for future **innovation** in the field.

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