

A structured, blended learning program towards proficiency in epileptology: the launch of the ILAE Academy Level 2 Program

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ABSTRACT

The ILAE Academy is the online learning platform of the International League Against Epilepsy (ILAE) and offers a structured educational program addressing the competency-based ILAE curriculum in epileptology. The platform was launched in July 2020 with a self-paced course portfolio of interactive e-learning modules addressing ILAE Level 1 learning objectives, defined as the entry level in epileptology. Using feedback questionnaires from completed Level 1 courses as well as sociodemographic and learning-related data obtained from 47 participants, we show that over 50% of learners have an entry level in epileptology and do not have access to on-site training and over 40% do not have access to on-site training. Most respondents found the case-based e-learning modules relevant to their practice needs, and the time for completion was regarded as viable for most, reiterating the value of an online self-paced training in the field. Participants who have successfully completed all compulsory e-learning material of the Level 1 program and received their final certificate will now be eligible to subscribe to the Level 2 program. The Level 2 program addressing the proficiency level of the ILAE curriculum of epileptology was launched on the ILAE Academy platform in May 2022. The Level 2 program will offer an evolving series of self-paced, interactive, case-based e-learning modules on diagnosis, treatment, and counseling of common as well as rare epilepsies at a higher level of care. An interactive online EEG and MRI reader was developed and is embedded into the course content to satisfy the demands of the learners. The hallmark of this level will be the blended learning with tutored online courses, e.g., the established VIREPA courses on EEG and the newly introduced VIREPA MRI program. Our distinguished faculty will hold live tutored online courses in small groups in various languages and continental time zones. Finally, the ILAE face-to-face curricular teaching courses at summer schools and congresses will represent another pillar of this advanced teaching level. The ILAE Academy will also provide Continuing Medical Education (CME) credits to support career planning in epileptology.

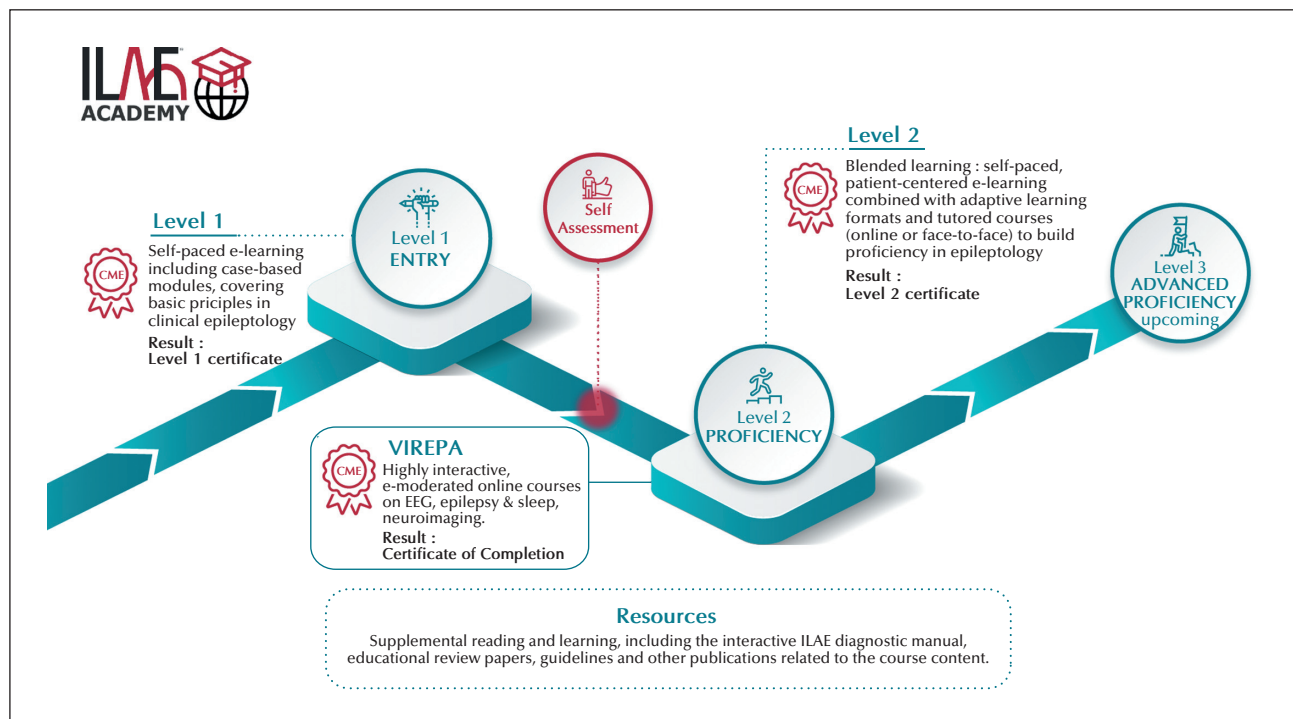
Key words: International League Against Epilepsy (ILAE), curriculum in epileptology, e-learning, Level 2 program

The Level 1 e-learning experience from July 2020 to December 2021

On July 6th, 2020, the International League Against Epilepsy (ILAE) launched its teaching Academy. Overseen by the ILAE Education Council, the ILAE Academy is a *not-for-profit* initiative based on a commercially available learning management system (LMS), *i.e.*, Totara Learn. The deployment of ILAE Academy learning activities was envisioned to occur in stages, addressing entry-level knowledge in epileptology in the first phase and progressing to more advanced knowledge in subsequent phases (*figure 1*). The first phase of the ILAE's new teaching endeavor, *i.e.*, Level 1 according to the ILAE curriculum [1], consisted of a self-paced course program, developed from the ground up and made available online (www.ilae-academy.org). With over one million page views, more than 39,000 visitors, and more than 2,000 registered active users from 62 countries covering all continents (*see table 1 for the specified time period*), the ILAE Academy is off to a successful start, ostensibly filling an important gap in comprehensive education in epileptology [1, 2]. The ILAE Academy has now launched its Level 2 program, addressing

proficiency learning objectives in epileptology. In addition, CME credits will be available for educational activities, further enhancing continuing professional development (CPD).

The ILAE Academy Level 1 program is primarily intended for clinicians trained in adult or child neurology, internal medicine, pediatrics, and psychiatry who manage people with epilepsy (PwE). However, it is also relevant to other professionals involved in providing care to PwE and seeking CPD in epileptology. The content covers the basic principles in clinical epileptology which are needed to diagnose [3, 4] and manage the most common forms of seizures and types of epilepsy (*see table 2*) but also flags common errors in clinical decision-making [5, 6]. Participants draw clinically meaningful conclusions from the information presented and apply them directly to initial management decisions. These include making the correct diagnosis, choosing appropriate pharmacological therapy according to seizure type, implementing emergency treatment plans, and providing guidance to persons with epilepsy regarding social issues, lifestyle, safety measures, and risk of adverse outcomes such as sudden unexpected death in epilepsy (SUDEP). Learners need to pass a multiple-



■ **Figure 1.** Graphical abstract of the structured learning program of the ILAE Academy. We kindly thank Jason Ryan for creating the graphical abstract for ILAE. CME – continuing medical education; CME credit points will be made available for selected course materials in indicated levels.

▼ **Table 1.** Summary of ILAE Academy Level 1 statistics from Jul 2020 to Dec 2021.

Pageviews (Google Analytics)	1,061,082
ILAE Academy website visitors	39,050
Certificates issued for Level 1	5,925
Active users of the ILAE Academy	2,145
Certificates issued for case-based e-learning modules	1,901
Participants registered for the Level 1 teaching course	381
Countries involved*	62
Mean hours spent for a case-based e-learning module	2-3

*List of 62 countries recognized by the ILAE Academy learning management system: Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Brazil, Canada, Colombia, Costa Rica, Denmark, Ecuador, Egypt, Arab Rep., El Salvador, Finland, France, Germany, Guatemala, Honduras, Hong Kong SAR, China, India, Indonesia, Iran, Islamic Rep., Iraq, Ireland, Israel, Italy, Japan, Kenya, Korea, Rep., Kuwait, Malaysia, Mexico, Moldova, Morocco, Nepal, Netherlands, Nigeria, Norway, Oman, Pakistan, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russian Federation, Saudi Arabia, Spain, Suriname, Sweden, Switzerland, Syrian Arab Republic, Taiwan, China, Thailand, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, Vietnam.

choice exam for each teaching module, which certifies their successful completion of the course (see *table 1*) and also endorses their promotion to Level 2. Learners could individually select their courses of interest from a dashboard listing all modules available in the Level 1 portfolio. In addition, they could choose to start with free access to case-based e-learning modules, access a preselected choice of topic-oriented *ebrain* sessions, or engage in the full package of the Level 1 course content covering all 40 learning objectives specified in the ILAE curriculum for epileptology. Following is a brief description of the main offerings available to learners through the ILAE Academy Level 1 program.

Case-based e-learning modules

The full Level 1 portfolio included a total of 15 case-based e-learning modules addressing the most common epilepsies in adults and children (*table 2*). During two weeks following the launch of each new case on the platform, learners were given access to an online forum that allowed them to exchange views and queries with the authors and consulting ILAE experts. It took students 2-3 hours on average to complete a case-based e-learning module (*table 1*). In addition, students had to pass a multiple-choice exam

in each case-based e-learning module to certify the successful completion of the course.

As shown in *table 2*, the course authors and consulting ILAE experts encompassed early career and senior epileptologists from a wide range of disciplines and with broad demographic and geographic representation. *The ILAE Education Council is most grateful to all our volunteering authors and consulting experts for their efforts to develop this unique teaching material.* A detailed analysis of feedback questionnaires received from 2,129 completed course modules revealed that 77% of the learners judged the patient-based approach as excellent on the whole (on a 3-point answering scale from “excellent” to “fair”). In total, 76% rated the value of the self-paced format very valuable (on a 5-point scale from “very valuable” to “not valuable at all”) and 97% of the learners would recommend the course to others. Overall, 62% participants rated themselves to belong to Level 1, 33% to Level 2, and 6% to Level 3.

ebrain microlearning

A series of 50 microlearning modules covering a comprehensive knowledge base in epileptology was developed by the Joint Neurosciences Council of the United Kingdom and licensed to use in the ILAE Academy (*table 3*). All micromodules have been reviewed by ILAE experts and their content has been revised accordingly before the Education Council agreed to launch all *ebrain* sessions. The expected time to complete each micromodule was about 20 minutes and completion was certified after passing a short exam of multiple-choice questions. The ILAE Academy content development group of the Education Council selected 26 of these *ebrain* sessions as compulsory microlearning modules, which learners must complete to earn the Level 1 certificate (*table 3*). In the period from July 2020 to December 2021 our web-statistics revealed that 3,710 learners have enrolled in the *ebrain* modules, 2,294 *ebrain* modules were successfully completed and a total of 46,324 visits to the *ebrain* modules were registered.

Epilepsy Imaging: a new online MRI reading and teaching program

A self-directed, new online MRI reading and teaching tool was developed for the ILAE Academy, *i.e.* “Epilepsy Imaging”, which allows a learner to comprehensively study the most common structural etiologies underlying focal epilepsies. The course content addresses 10 patients with different causes of focal epilepsy. Assisting teaching materials are iteratively disclosed, starting with a short clinical history of the patient and a series of MRI stacks dynamically readable online as with most clinical MRI readers. In a

▼ **Table 2.** List of case-based e-learning modules in Level 1 of the ILAE Academy.

Course	Epilepsy diagnosis	Case authors	Consulting ILAE experts
1	Rolandic epilepsy	Jan-Christoph Schoene-Bake	Alexis Arzimanoglou, Mary Lou Smith, Raidah Al-Baradie
2	Juvenile myoclonic epilepsy	Christina Giavasi	Hannah Cock, Leonor Cabral-Lim, Michalis Koutroumanidis, Kette D. Valente
3	Mesial temporal lobe epilepsy (MTLE)	Manuela Ochoa-Urrea	Sandor Beniczky, Ingmar Blümcke, Marco Mula
4	Childhood absence epilepsy	Sebastian Ortiz De La Rosa	Raidah Al-Baradie, Jo Wilmshurst, Kirsty Donald
5	Neurocysticercosis	Natalia V. Figueiredo, Marcelo Schmid	Elza M. Yacubian, Jaime Carrizosa, Kette D. Valente, Kirsty Donald
6	New-onset status epilepticus (SE)	Bernd Vorderwülbecke	Martin Holtkamp, Andrea Rossetti, Markus Reuber
7	Brain tumor	Joshua Laing	Terence O'Brien, Andrew Neal
8	Post-stroke epilepsy (adults)	Ana Suller Marti, Bernd Vorderwülbecke	Jorge Burneo, Man Mohan Mehndiratta, Rosa Michaelis
9	Focal epilepsy with cortical dysplasia	Hugh Simpson	Simon Harvey, Ingmar Blümcke, Kette D. Valente
10	Psychogenic non-epileptic seizures (PNES)	Jessica Fesler	Jocelyn F. Bautista, Markus Reuber
11	Malaria	Maureen Njoroge, Nicholas Odero	Samson Gwer, Jo Wilmshurst
12	Meningoencephalitis incl. COVID-19	Takafumi Kubota	J Helen Cross, Guadalupe Fernandez-Baca Vaca, Man Mohan Mehndiratta
13	Febrile seizure	Artem A. Sharkov, Marion Comajuan	Joseph Toulouse, Kette D. Valente, Elena D. Belousova
14	Idiopathic generalized epilepsy	Patricia Gomez Iglesias	Irene Garcia Morales, Carmen Barba, Rosa Michaelis
15	Traumatic brain injury	Paula B. Campos, Christina Giavasi	Rainer Surges, Roland D. Thijs, Rosa Michaelis

second stage, screenshots from the patient's EEG recordings are released to allow learners an assessment of the possible seizure onset zone and refine their MRI analysis. Each case presentation concludes with a short exam to test the learner's correct assessment of the MRI findings, all of which are confirmed by disclosure of the histopathology of the surgically resected lesion. The teaching material also includes preselected textbook chapters about MRI techniques and MRI signatures in common epileptogenic brain lesions, which cover the knowledge base of neuroimaging in epileptology.

Histopathology in a nutshell

Structural brain lesions of the human neocortex are a common cause of drug-resistant focal epilepsy and are amenable to neurosurgical treatment [7]. The

ILAE's teaching curriculum for epileptology considers histopathology as an important competency, therefore, for the diagnosis, prognostic counselling and management of PwE [1]. A series of 10 videotutorials, each 10-20 minutes in duration, introduces learners to the basics in histopathology, starting with the presentation of laboratory staining techniques and their common artefacts, recognition of anatomical landmarks of the human neocortex and hippocampus, as well as the characteristic response of neuroepithelial cells to common pathophysiological mechanisms, e.g., inflammation, neoplasia, ischemia, or neurodegeneration. The final tutorial covers the most common disease entities encountered in epilepsy surgery. Successful completion will empower the participant to recognize abnormal cell patterns characteristic for a neoplastic, infectious, traumatic, and neurodegenerative cause of the underlying brain

▼ **Table 3.** List of all *ebrain* microlearning modules in Level 1 of the ILAE Academy.

1. Acute Symptomatic Seizures	26. Management of Epilepsy in the Elderly
2. An introduction to neurological assessment	27. Management of Women with Epilepsy: Reproductive Issues
3. Assessment and Treatment of Refractory Epilepsy	28. Monitoring Drug Therapy
4. Assessment of Patients Presenting with Blackouts	29. MR Based Imaging Techniques
5. Brain Imaging in Seizures and Epilepsy	30. Neurological History: general approach and common pitfalls
6. Cardiac Syncope	31. Neuropsychiatry of Depression in epilepsy
7. Causes of Epilepsy - Symptomatic	32. Neuropsychiatry of epilepsy
8. Childhood Absence Epilepsy	33. Non-convulsive Status Epilepticus
9. Choosing Antiepileptic Drugs for Focal Epilepsy	34. Occipital and Parietal Lobe Epilepsies
10. Choosing Antiepileptic Drugs for Generalized Epilepsy	35. Other Childhood Epilepsy Syndromes
11. Cognitive assessment in epilepsy	36. Palliative Surgical Treatments for Epilepsy
12. Convulsive Status Epilepticus	37. Performing a neuropsychiatric examination
13. CT Based Imaging techniques	38. Pregnancy and Epilepsy
14. Diagnosis of Frontal Lobe Epilepsy	39. Principles of neurological investigation
15. Diagnosis of Temporal Lobe Epilepsy	40. Role of EEG in the Diagnosis of Epilepsy
16. Differential Diagnosis of Blackouts and Epilepsy	41. Social Consequences of Epilepsy
17. Dissociative (non-epileptic) Seizures	42. Starting Epilepsy Treatment
18. Epilepsy and Intellectual Disability	43. Temporal Lobe Surgery for Epilepsy
19. Epilepsy and psychosis	44. The Causes of Epilepsy: Idiopathic Epilepsy
20. Epilepsy in Adolescence	45. The Classification of Seizures and the Epilepsies
21. Epileptic Seizures and Syndromes in Neonates and Infants	46. The Diagnosis of Dissociative (Psychogenic Non-epileptic) Seizures
22. Identifying epilepsy through patient videos: A guide for medical students and junior doctors	47. The Diagnosis of the (Reflex) Vasovagal Syncope
23. Idiopathic (genetic) Epilepsy	48. The Management of Non-Epileptic Seizures
24. Interactions of Antiepileptic Drugs	49. The Mental Status Examination in Neurology
25. Management of Epilepsy in Remission	50. Use of Antiepileptic Drugs in Refractory Epilepsy

ebrain microlearning modules compulsory for the Level 1 certificate are highlighted in bold.

lesion, and interpret histopathology reports in the clinical context.

Summary of the pre- and post-course survey analysis for Level 1¹

The nature of a self-paced online course poses specific potentials and challenges to learners, which makes it imperative for the success of such a course to monitor learners' characteristics. Therefore, in

¹ Detailed information on how the study was conducted as well as the collected data can be obtained from the authors at reasonable request.

order to gain insights into the participants' personal and professional profile, motivation, experience, and challenges with the self-paced e-learning program, pre-, mid- and post-course surveys were conducted. The surveys were deployed in English via the learning management system of the research institution² and participants received the

² Responsible researchers for this study, Ass. Prof. Dr. Svenja Bedenlier (svenja.bedenlier@ili.fau.de), at the Innovation in Learning Institute and PD. Dr. Marion Händel (marion.haendel@uni-a.de), at the Department of Psychology at Friedrich-Alexander-University Erlangen-Nuremberg (Germany).

link to the questionnaire via e-mail. In contrast to the mandatory completion of other evaluation forms of the training, participation in this survey was voluntary. Before the first questionnaire implementation, clearance from the data protection officer was obtained. The pre-course survey comprised an assessment of socio-demographic information, as well as attitudes and expectations related to the program and self-assessment of individuals' learning style in self-paced online training. The mid- and post-course surveys focused on participants' self-efficacy and participation throughout the program. With the program relying on self-paced studying, the measurements were made over estimated time periods, starting in July 2020 to September 2020, to reach about 100 participants, followed by the mid-course survey in October 2020 and post-course survey from April to August 2021, with reminder emails to enhance completion.

Demographic information from pre-survey

Overall, 47 participants provided data in the pre-course survey (accessible at the start of the self-learning courses); detailed sample information is given in *table 4*. Participants practiced in 32 different countries; none of the respondents reported working in rural areas [7]. The most frequent profession was a physician (neurologist), focusing either on adults (40.4%) or children (36.1%). The years of professional experience in epileptology were distributed rather evenly. Access to on-site training offerings in epileptology was not available in their country (42.6%) or in their region (12.8%) of residence. For 29.7% of participants, on-site training was also available and had been accessed. It is not known whether these numbers were affected by the COVID-19 pandemic leading to restrictions to on-site learning and challenges in the respective national conditions. Almost half of the respondents (46.6%) stated that their primary motivation to enroll in the course was their need to improve their knowledge and understanding of the subject, and the vast majority (91.3%) stated that it was solely their personal decision to participate in the course. With regards to prerequisites for the course participation, participants mostly used either a laptop (76.6%) and/or a desktop personal computer (40.4%) and reported to have stable (53.1%) or sufficient (44.6%) internet connection.

Evaluation of participation and self-efficacy based on the post-course survey

The final survey was distributed after participants completed – or could be expected to have completed

– most of the Level 1 courses, resulting in 43 responses. Unfortunately, we could not match meaningful numbers of participants from the pre-course with the post-course survey, despite working with an individually designed code to allow for such a match throughout the surveys. In total, 53.5% of participants reported their proficiency level in epileptology as being at entry level and 46.5% as proficient. *Table 5* informs about the mean values of the post survey. Participants' self-efficacy in regards to self-regulated learning during a self-paced online course was relatively high [8]. Based on a 5-point-Likert scale, on average, participants showed average values regarding utility of the course for job purposes [9].

Implications and limitations

These results indicate that the self-paced learning program succeeded in reaching a diverse range of professionals working in or embarking on the field of epileptology, oftentimes with little prior experience and (currently) lack of access to on-site training in their respective countries of work. Participants also reported to predominantly work in urban areas where health education and infrastructure tend to be better resourced. Given the intensity and length required to specialize in epileptology – as in other medical fields – the self-paced training program cannot be expected to realize a full-fledged epileptology education. However, such self-paced online learning can contribute to gain of knowledge in epileptology (rated as “good” in 46.5%, “high” in 34.9% and “very high” in 11.6%), especially in areas or during times of restricted access to on-site training. In addition, the online educational tools of the ILAE Academy bear the potential for standardizing the educational activities related to epilepsy, e.g., in residency and fellowship programs worldwide.

Increasing access to the new Level 1 course portfolio in 2022

In the beginning of 2022, the Level 1 course content, as described above, was adapted in order to support the ILAE's not-for-profit pricing policy and to make its content as widely accessible as possible for new users. The new Level 1 course program in 2022 will contain all 15 case-based e-learning modules (*table 2*), the 26 compulsory *ebrain* sessions (*table 3*), and the histopathology-in-a-nutshell tutorials (Level 1). The MRI reading and teaching tool will no longer be accessible, however, at teaching Level 1. Again, the learner has to engage in this full package of teaching materials to complete this level and earn the certificate. The case-based e-learning program of the new Level 1 will also be CME accredited by the American

▼ Table 4. Pre-survey sample characteristics.

Variable	Characteristic	Proportion of participants [%]
Gender	Male	42.6
	Female	57.4
Age	Between 20 and 29	2.13
	Between 30 and 39	38.30
	Between 40 and 49	27.66
	Between 50 and 59	25.53
	>60	6.38
Proficiency level	Entry	55.3
	Proficient	50.5
	Advanced proficiency	4.2
Years of professional experience	< 2 years	25.53
	2-4 years	21.28
	5-10 years	17.02
	11-15 years	10.64
	16-20 years	17.02
	> 20 years	8.51
Workplace location	Large metropolitan area (population >1.5 million)	40.43
	Medium-size urban area (population: 200,00 - 500,000)	14.89
	Metropolitan area (population: 500,000 - 1.5 million)	38.30
	Small urban area (population: 50,000 -200,000)	6.38

Association for Continuing Medical Education (AACME). Translation to other languages is crucial to increase access around the world to the ILAE Academy. Accordingly, all e-learning content is being

translated into Spanish and Portuguese, and the Education Council continuously seeks volunteers to help to translate into Arabic, Russian, Mandarin, French, Italian, and German.

▼ Table 5. Post-survey results.

Variable	Sample item	Frequency (%)	Number of items	Answer scale	M (SD)
Time spent	One hour per week	32.6%	-	-	-
	One hour per day	32.6%	-	-	-
	More than 7 hours per week	9.3%	-	-	-
Self-efficacy	I am confident I can learn without the presence of an instructor to assist me	-	5	7-point-Likert	5.64 (1.20)
Utility for job	Participation in this online training course can be of great value to me later on	-	2	5-point-Likert	3.82 (1.26)

Transition from Level 1 to Level 2 using a confidence-based exam

The Education Council envisages two options for a learner to enter the ILAE Academy's proficiency Level 2. The first option is the successful completion of all compulsory teaching materials of Level 1. The second option applies to learners who do not complete or participate in the Level 1 program with its final certificate. Yet, these learners have to demonstrate sufficient knowledge and competency in epileptology to ensure success in the learning activities contained in Level 2. Accordingly, the applicants for Level 2 have to take the newly designed confidence-based exam comprised of 30 questions which are randomly selected from the compulsory exams at the end of each case-based e-learning module of Level 1. These 30 questions cover the competencies of Diagnosis, Counseling, Treatment and Emergencies according to the learning objectives specified in the ILAE curriculum for Level 1 [1]. For each question, applicants have to give the correct answer and state their level of confidence [10]. Both numbers contribute to the final score necessary to pass the test. The confidence rating has three levels, *i.e.*, *unsure – mid – quite sure*. A correct answer given either without confidence, with mid confidence or with high confidence receives a corresponding score of 1 point, 2 points or 3 points, respectively. If the answer is incorrect, the score corresponding to the three levels of confidence will be 0 points, -2 points or -6 points. Answering all questions correctly but without confidence is not sufficient to pass the exam. Test results will also highlight the performance in various competency domains. The aim is to help learners to better prepare for the re-test, or to highlight critical areas that require strengthening even if a pass mark was marginally obtained. Importantly, all learners engaged in the full package of Level 1 will have free access to the confidence-based transition exam, although their final Level 1 certificate will be sufficient to reach the next level.

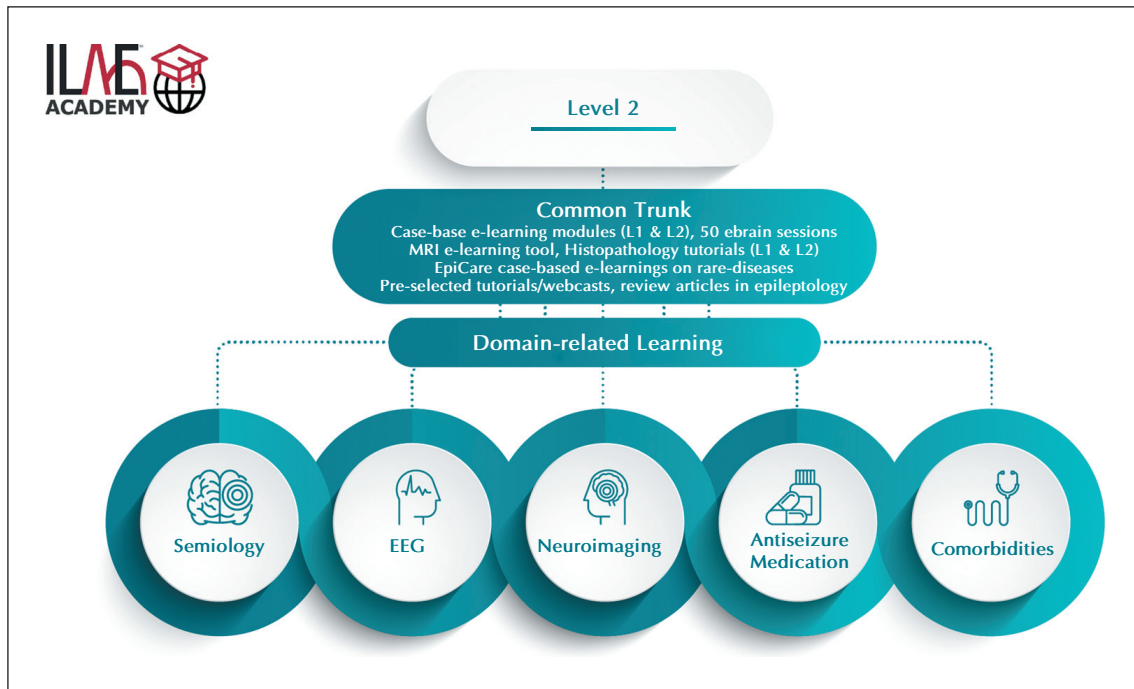
The Roadmap to a structured, blended learning program towards proficiency level in epileptology (Level 2)

The concept of Level 2 is similar to that of Level 1, *i.e.*, a patient-centered educational approach [11, 12], which addresses adult learning styles and needs [13-16] in a global environment with different socio-cultural contexts and online access to educational activities [16]. We emphasize the importance of acknowledging adult learning principles, *i.e.*, andragogy, defined as the art and science of adult learning, in contrast to

pedagogy for children or adolescents [17]. Learning activities should be of practical relevance, goal-oriented and outcome-based, and the learner's readiness and motivation to learn should be fostered by actively performing specific tasks [18]. Therefore, we have designed a comprehensive teaching portfolio with new interactive tools integrated into our well-established case-based e-learning modules. In addition, we have implemented the concept of adaptive e-learning to address knowledge-based content which is difficult to provide by presentations of single cases. According to the published curriculum roadmap [1], this next level of education in patient care covers a broader and deeper spectrum of knowledge and skills in epileptology. The complexity of the different forms of epilepsy, the diversity of underlying etiologies, and the large number of available investigations that have to be prioritized and correctly selected based on clinical considerations and cost-effectiveness require specific training beyond that of general neurology or child neurology. Therefore, proficiency in video-EEG and MRI interpretation for neurologists and child neurologists will be extensively covered in Level 2 (*figure 2*). The same applies to the complexity of available therapeutic strategies and their immediate and long-term consequences, which requires motivation, knowledge, and adaptation of professional behavior to ensure best clinical practice.

The ILAE Academy Level 2 program offers, therefore, a global, patient-centered approach that incorporates knowledge and skills that allow learners to build a comprehensive clinical hypothesis. This hypothesis is based on the pathophysiological and anatomical grounds corresponding to each type of epilepsy, which in turns leads to choosing appropriate first and second-line anti-seizure medication (ASM), and to early recognition of the indications for referral for pre-surgical evaluation. This includes the capacity to inform and counsel the patient and family on prognosis, lifestyle, social aspects, and risks for serious adverse outcomes. The global approach also covers skills and knowledge to deal with special patient groups, including women of childbearing age, the elderly, and those suffering from psychiatric or somatic comorbidities.

A hallmark of the instructional design of Level 2 learning activities will be the combination of self-directed online learning with tutored teaching courses, *i.e.*, a blended learning approach as specified further below. To accomplish the learning goals of Level 2 and finally be promoted to Level 3, the highest expert proficiency level of the ILAE's educational curriculum, we offer a series of online live events or face-to-face teaching at specified ILAE curricular summer schools, via ILAE endorsed teaching courses, or at ILAE congresses [19]. The resources already



■ **Figure 2.** Schematic organization of Level 2 teaching materials of the ILAE Academy.

introduced in Level 1 will remain accessible and will be further developed to encompass the large body of essential literature, peer reviewed seminars in epileptology published in *Epileptic Disorders* (table 6), and evolving databases for the analysis and interpretation of diagnostic tools, such as EEG and MRI.

To help learners navigate the growing and changing corpus of teaching materials, the learning path is conceptualized into a common trunk of teaching materials and additional opting in specific domains (figure 2). Courses in the common trunk are compulsory for all learners in Level 2 in order to be promoted to Level 3. Nonetheless, successful completion of all materials in the common trunk is not sufficient to reach Level 3, and learners must choose additional training in specific domains, *i.e.*, addressing seizure semiology, neurophysiology, neuroimaging, ASM treatment, or comorbidities. However, learners with a full subscription to Level 2 of the ILAE Academy will have access to all the teaching materials described above.

The Level 2 teaching portfolio

Selected case-based e-learning modules from Level 1 have been upgraded to address the learning objectives of Level 2 (figure 3). The instructional design was

adapted accordingly and implemented microlearning modules for the following topics: (1) semiology based on select patient videos; (2) EEG diagnosis using a new interactive online EEG reader; (3) assessing the differential diagnosis of relevant etiologies and including neuroimaging where applicable; (4) pharmacological treatment based on the patient's epilepsy classification and using the EpiPick-online tool when appropriate ([20], see also <https://epipick.org>); and (5) patient counselling, including prevention, lifestyle, outcomes, and referral to presurgical evaluation when appropriate.

The adaptive e-learning program used by the ILAE Academy was developed using state-of-the-art expertise provided by Area 9 Lyceum (https://en.wikipedia.org/wiki/Area9_Lyceum [21]). This self-directed e-learning concept will address learning objectives that are highly relevant to the Level 2 course program but may not be fully covered by the case-based e-learning modules. This new, adaptive e-learning approach uses confidence-based grading of quizzes, repetition, and reinforcement with additional learning resources. A first course has been developed for psychiatric comorbidities, *i.e.*, depression in adult PwE, and will be made available with the launch of the Level 2 program. Additional adaptive e-learning courses will be continuously added as content is further developed.

▼ **Table 6.** List of open access “Seminars in Epileptology” supplementing the ILAE Academy learning portfolio.

Title of published seminar	Addressed learning objectives	Teaching level	Reference
The aetiologies of epilepsy	1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6, 1.1.7	Level 1 Level 2	[26]
Management of a first unprovoked epileptic seizure in adolescence and adulthood	1.1.1, 1.3, 1.4.1, 1.5.2, 1.6, 1.8.4	Level 1	[27]
How to diagnose and treat post-stroke seizures and epilepsy	1.1.2, 1.5.2	Level 2	[28]
Epilepsy in neurodegenerative diseases	1.1.7, 6.1, 6.2.1, 6.2.2, 6.2.3	Level 2 Level 3	[29]
How to distinguish seizures from non-epileptic manifestations	1.3.1	Level 1	[30]
The importance of semiological information based on epileptic seizure history.	1.3.2	Level 1	[3]
Seizure semiology: ILAE glossary of terms and their significance	1.3.3, 1.3.4	Level 1 Level 2	[31]
The role of EEG in patients with suspected epilepsy	1.4.1	Level 1	[32]
Electroencephalography: basic biophysical and technological aspects important for clinical applications	1.4.2, 1.4.3, 1.4.4, 1.4.5, 1.4.6	Level 2	[33]
Learn to interpret voltage maps: an atlas of topographies	1.4.4	Level 2	[34]
MRI essentials in epileptology: a review from the ILAE Imaging Taskforce	1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.5, 4.3.2	Level 1 Level 2	[35]
Testing blood and CSF in people with epilepsy: a practical guide	1.6	Level 1	[36]
Acute symptomatic seizures: an educational, evidence-based review	1.7.1	Level 1 /Level 2	[37]
Developmental and epileptic encephalopathies	1.7.2	Level 1	[38]
Electroclinical markers to differentiate between focal and generalized epilepsies	1.7.2	Level 1	[39]
How to diagnose and classify idiopathic (genetic) generalized epilepsies	1.7.4	Level 1	[40]
The aetiology of psychogenic non-epileptic seizures: risk factors and comorbidities	1.8.1	Level 1	[41]
Identifying patients with epilepsy at high risk of cardiac death: signs, risk factors and initial management of high risk of cardiac death.	1.8.4, 1.9.1	Level 1	[42]
Living safely with epilepsy: a key learning review	2.2.2, 2.2.3	Level 1	[43]
Women’s issues	2.6, 2.6.2, 2.6.3	Level 2	[44]
Indications and expectations for neuropsychological assessment in epilepsy surgery in children and adults	2.8.1, 2.9.1, 4.2.1, 6.1.1	Level 2	[45]
Management of epilepsy in pregnancy: a report from the International League Against Epilepsy Task Force on Women and Pregnancy	2.8.2	Level 2	[46]
How to understand and address the cultural aspects and consequences of diagnosis of epilepsy, including stigma	2.10.1	Level 1	[47]
Epilepsy in adults with neurodevelopmental disability – what every neurologist should know	6.1.4	Level 3	[48]

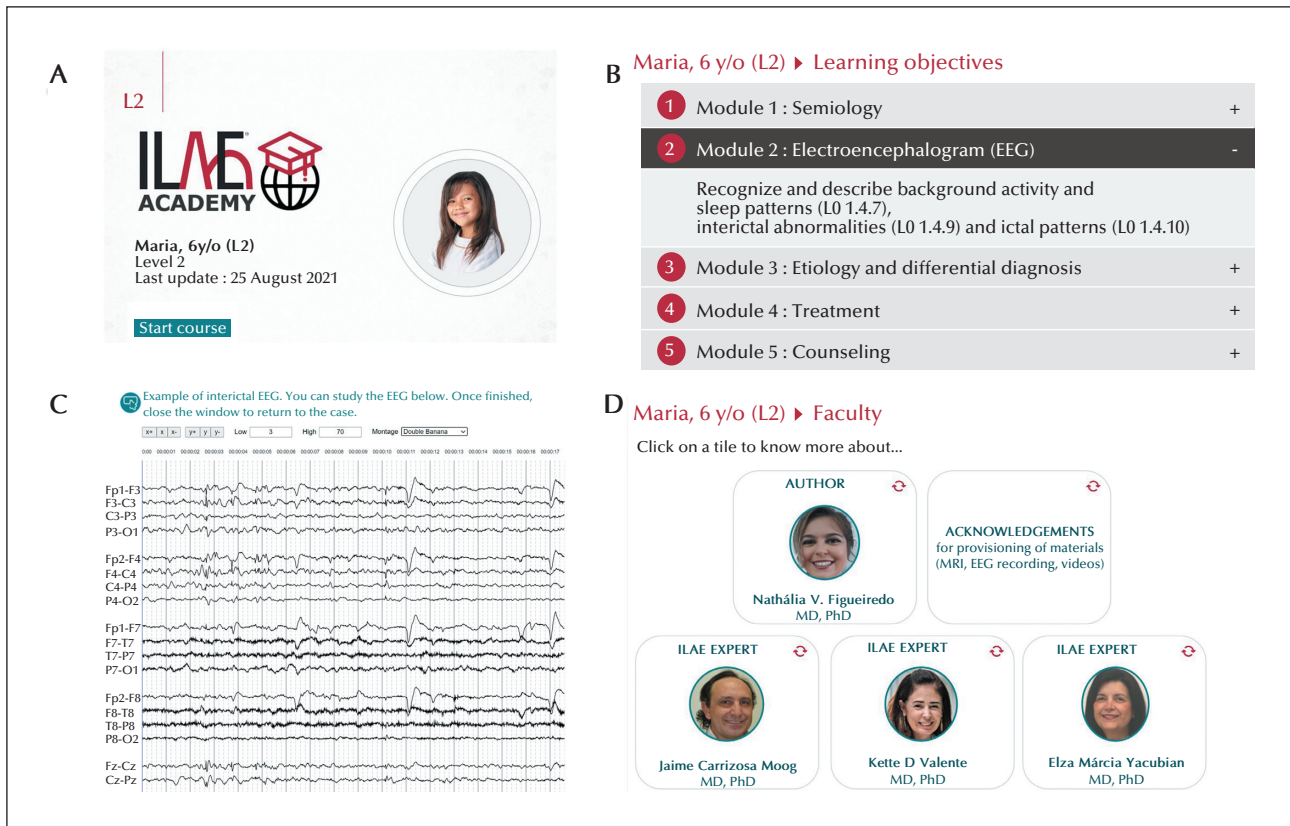


Figure 3. The instructional design of the new case-based e-learning module at Level 2. (A) The introduction of each case-based e-learning course includes a user guide, introduces the learning objectives according to the ILAE curriculum, recognizes the author and ILAE experts involved in content development (see (D)), and provides an audio recording summarizing the case highlights and challenges. (B) The modular design of microlearnings addresses *Semiology* (Module 1), *EEG* (Module 2), *Etiology* (Module 3), *Treatment* (Module 4), and *Counseling* (Module 5). The learner has to pass a short test with multiple choice questions to access the next module. (C) Each course provides an online EEG reader which can be interactively used by the learner to review the patient’s EEG and recognize specific grapho-elements (pending the specific task given). Each successfully accomplished course will provide the learner with CME credits.

New e-semiology microlearning modules have been developed to recognize and correctly classify a patient’s seizure. This program is based on a series of patient videos selected by our expert faculty. The instructional design of the module will allow the learner to recognize and classify each stage of an evolving seizure necessary to correctly classify the seizure and build a hypothesis about the anatomical localization of its onset. The MRI reading and teaching platform was previously assigned to the Level 1 course material. It has now been transferred to Level 2 in order to support the learner’s proficiency in MRI diagnosis of common epileptogenic brain lesions. It is also used to support the new VIREPA MRI teaching course at Level 2. Case-based e-learning modules on rare and complex epilepsies have been developed in

cooperation with the European Reference Network “EpiCARE” and will be included and fully accessible in our Level 2 teaching portfolio. Histopathology-in-a-nutshell tutorials for Level 2 have been produced to cover the most common epileptogenic brain lesions encountered in epilepsy surgery cases. Additional resources in Level 2 will include recorded lectures from the ILAE International Epilepsy Congress, tutorials, and EpiCARE webinars (<https://epi-care.eu/past-webinars>), as well as published seminars in epileptology (table 6).

The ILAE’s blended learning program for Level 2

The “blended learning approach” combines different teaching modalities [22] and this terminology is used

herein to describe the mixing of self-directed online ILAE Academy courses with event-based teaching activities, including virtual live tutored courses, face-to-face (f2f) courses at ILAE summer schools, ILAE-endorsed courses as announced on the ILAE website (www.ilae.org) and ILAE congresses, or tutored VIREPA online courses. The shut-down of *in-person* training courses during a pandemic, but also socio-economic as well as language barriers are well-recognized and ongoing obstacles for our learners around the world. The blended learning model can help to bridge this gap and has experienced significant growth during the past years [2, 23], especially in medical education [24]. Blended learning will thus play a continuous role in the instructional design of the structured learning program of the ILAE Academy.

Offerings in education of epileptology are vast around the world and organized by various bodies, societies or companies. The Education Council will continue to oversee educational activities developed by the ILAE, its regional commissions and national chapters, and will highlight those relevant to the ILAE curriculum to support the blended learning concept in Level 2. The currently approved activities include the online VIREPA courses for EEG and MRI. Curricular courses of the ILAE Academy include topic-oriented Summer Schools, *i.e.*, Neuroimaging, EEG in neonates, advanced EEG analysis, Neuropsychology, and Neuropathology. Venues and dates for these courses will be continuously updated on the ILAE website. International and regional ILAE congresses will continue to offer an educational portfolio addressing pharmacological treatment, video sessions, counseling, epilepsy diagnosis, management of status epilepticus, neuroimaging, VIREPA f2f courses or EEG in diagnosing patients with epilepsy [19]. In addition, the ILAE Academy will launch a new series of tutored live courses (web-tutorials), tailored to the learners' most appropriate time zone and language. Teaching will take place in small groups of up to 10 students and tutored by a distinguished faculty of ILAE experts to pre-defined topics, *e.g.*, learn by cases (adults and children), find the spike in EEG, new drug therapies, neuroimaging, and the histopathological basis of focal epilepsy.

The Education Council of the ILAE continues to develop state-of-the-art educational material for all communities and socio-economic resources around the world. Access to CME credits document and support these efforts and allow each learner to advance their professional career in accordance with national procedures and guidelines for CPD in each country. The previously described "learning planning cycle" of (1) defining the learning objectives, (2) assessing and validating the learning gaps, (3) defining the learning outcomes; (4) defining the educational

format, content and outcome measures, and (5) evaluating the achieved outcomes, therefore, is designed to build and maintain the most comprehensive portfolio for competency-based learning in epileptology [25]. ■

Supplementary material.

Summary slides accompanying the manuscript are available at www.epilepticdisorders.com.

Disclaimer

This report was written by experts selected by the International League Against Epilepsy (ILAE) and was approved for publication by the ILAE. Opinions expressed by the authors, however, do not necessarily represent the policy or position of the ILAE.

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